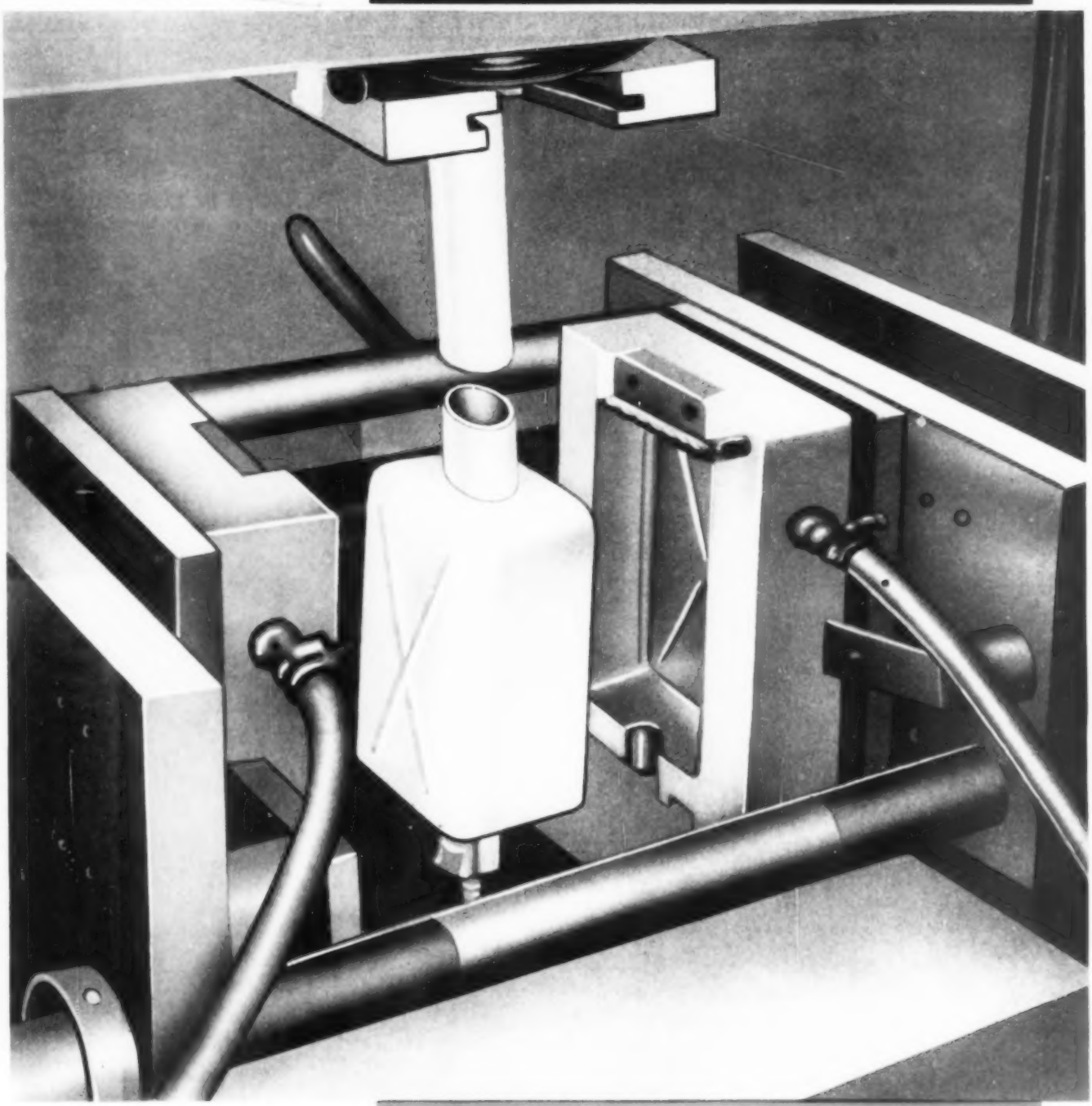
AUGUST 1958

PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING



BLOW-MOLDING ATTACHMENT SYNCHRONIZES WITH EXTRUDER TO MAKE PLASTIC BOTTLES

See Engineering Article/page 734

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Photographs courtesy of Jack & Heintz, Inc. and Ferroxcube Transformer Co., Inc.

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Four parts of **TENITE BUTYRATE** form this tough, lightweight nozzle

Here's a good example of how a switch to Butyrate plastic can mean an improved product, with savings in both material and manufacturing costs.

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Remember this use of Butyrate whenever you need a tough, outdoor plastic, readily adaptable to design. Tenite Butyrate is available in a wide range of flows and colors for injection molding or continuous extrusion. Look into the design and economy possibilities offered by this versatile plastic. For more information on Tenite Butyrate or any other Eastman plastic, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

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PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

AUGUST 1958 VOLUME IV NUMBER 8

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L. B. Croley and Robert Doyle

Extrusion conditions are discussed, with major emphasis on post-extrusion sizing techniques, and mention is made of suggested applications.

721 **ADHESIVE BONDING OF THE NEWER PLASTICS**
M. J. Bodnar and W. J. Powers

Results of an investigation of adhesives and pretreatments are given for Cymac 325, Delrin, diallyl phthalate, Lexan, Marlex 50, Grex Polyolefin, Moplen, Multrathane, and Penton to improve bonding.

726 **FLEXIBLE EPOXY RESINS** *W. J. Belanger and H. C. Klassen*

Results are given of an investigation comparing various curing systems for flexiblizing epoxy resin castings.

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SMITHSONIAN INSTITUTION AUG 2 0 1958

Letters to the Editor

Previews of Next Month

The following articles will be published In the September issue:

Influence of Resin and Process Variables on Polyester-Glass Laminate Properties. A. L. Smith, head, and W. G. Carson, staff member, Development & Applications Lab. for Polyester Resins, Rohm & Haas Co., Bristol, Pa.

Health Safety of Plastics. D. D. McCollister, Biochemical Research Dept., and W. J. Sauber, Plastics Customer Service Engr., Dow Chemical Co., Midland, Mich.

Reliable Properties Can Be Guaranteed. R. S. Jackson, ch. engr., Glastic Corp., Cleveland, O.

What a Plastics Engineer Should Look for When Planning to Buy an Extrusion Machine. R. E. Monica, Extrusion Section Head, Dow Chemical Co., Midland, Mich.

The Guest Editorial in the September issue will be "Research: The Key to the Plastics Crisis," by A. E. Gabriel, research project leader, Evans Research & Development Corp., New York, N. Y.

Highlights of this Issue

Extrusion of Rigid Polyethylene Pipe. (p. 717)

Extrusion conditions are discussed, with major emphasis on post-extrusion and sizing techniques. Of all methods, the cooled external sizing tube with internal air pressure appears easiest for maintaining size and shape of Marlex tubular goods. The article concludes with a brief discussion of suggested applications for rigid polyethylene pipe and tubing.

•

Adhesive Bonding of the Newer Plastics. (p. 721)

Results are given on adhesives and pretreatments for the adhesive bonding of Cyman 325, Delrin diallyl phthalate, Lexan, Marlex 50, Grex Polyolefin, Moplen, Multrothene, and Penton. It is suggested that superior bond strengths can be realized by a continued investigation of adhesives, curing systems, and variations in surface treatment.

•

Flexible Epoxy Resins. (p. 726)

Extensive test data are given to show that several systems are available for imparting a wide range of flexibility to epoxide resins. The cured resins from each system possess a characteristic set of physical and electrical properties that appears to depend primarily on the chemical nature of the flexibilizing agent.

"Injection Machine" Comments

Dear Sir:

Your injection machine section (pgs. 439-456 in May issue) was very well received here at Lombard, and we have heard a great number of favorable comments on it in the field.

I would, however, like to mention a few items which you may wish to consider in developing future articles of this type. Please accept these thoughts as constructive suggestions and not as criticisms:

(1). There was little mention made as to the importance of clamping stroke and maximum mold sizes available on equipment. As a matter of fact, the clamping stroke (minimum-maximum) was not even included in the list of specifications.

(2). The injection rate and plunger speed was not mentioned at all in the article. Machinery manufacturers are quick to point out any advantages they may have in these features to potential buyers of molding machines. As you well know, linear polyethylene cannot even be molded on some new machines due to their lack of injection speeds.

The above-mentioned specifications are ones which we found to be of considerable interest to the person planning on buying a molding machine. Such items as "dry cycles," "oil tank capacity," "hopper capacity," etc., are items seldom stressed to the molder.

I hope the above suggestions are of some value to you. We realize there are an infinite number of details involved in writing such an article, and certainly feel that you, Mr. Thayer, and your firm are to be complimented on a job "well done."

J. A. Nickerson
Injection Molding Machine Div.,
Lombard Governor Corp.
Ashland, Mass.

(We thank Mr. Nickerson for his comments. As stated in our June editorial, we consider the injection machine tabulation as only a step in the march toward standardization, so badly needed by plastics engineers. We feel certain that the next tabulation on injection machines, to be published either next year or the year after, will reflect many needed improvements over the May publication section. Comments from our readers are invited, both for and against.—Editor)

Information Wanted

Dear Sir:

We use a stencil tape in the printing of words on our player piano rolls.

Presently, we are seeking a substitute for the stencil roll with a very minimum of thickness plus tensile strength to allow speed-up of the printing process.

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Dear Sir:

Using plastic foils for manufacturing ladies' belts of various colors, we continually and on a large scale have plastic clippings and remnants. Now we are in search of a special machine that would allow us to work up and process plastic remainders in such a way that they could be utilized for reuse purposes.

Do you know of an American manufacturer of machines of this special kind, if there are any?

Max Geier
Stuttgart, West Germany

•

Dear Sir:

We are interested in purchasing a two or three horsepower steam generator which can be operated at 150 lbs.

We have seen such equipment discussed in your magazine, but cannot recollect the names of suppliers. Any information you can give us will be appreciated.

(Identity Withheld)

•

(All replies received here will be transmitted to the inquirer.—Editor).

We invite letters from our readers for publication in these colums. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

"Quote . . . Unquote"

Use of Vinyl in Trains

"At the same time that we are requiring new cars, our present fleet is undergoing constant repair. In these repair programs, cars are upgraded and their linings often restored to a new condition with the use of vinyl plastic sheets. These are used to repair damage to portions of the car interior and sometimes are used throughout the entire car. It might be possible that development of low cost plastic sheets which could be used in place of other finishes could further reduce repair costs as well as prolong car life.

"In connection with regular repairs to the electrical systems of cars and locomotives for some time, however, I might point out that whenever these tapes have been exposed to oils and certain paints, they have not proved too successful. Also, the cold flow characteristics of these tapes and their dielectric qualities have been somewhat disappointing.

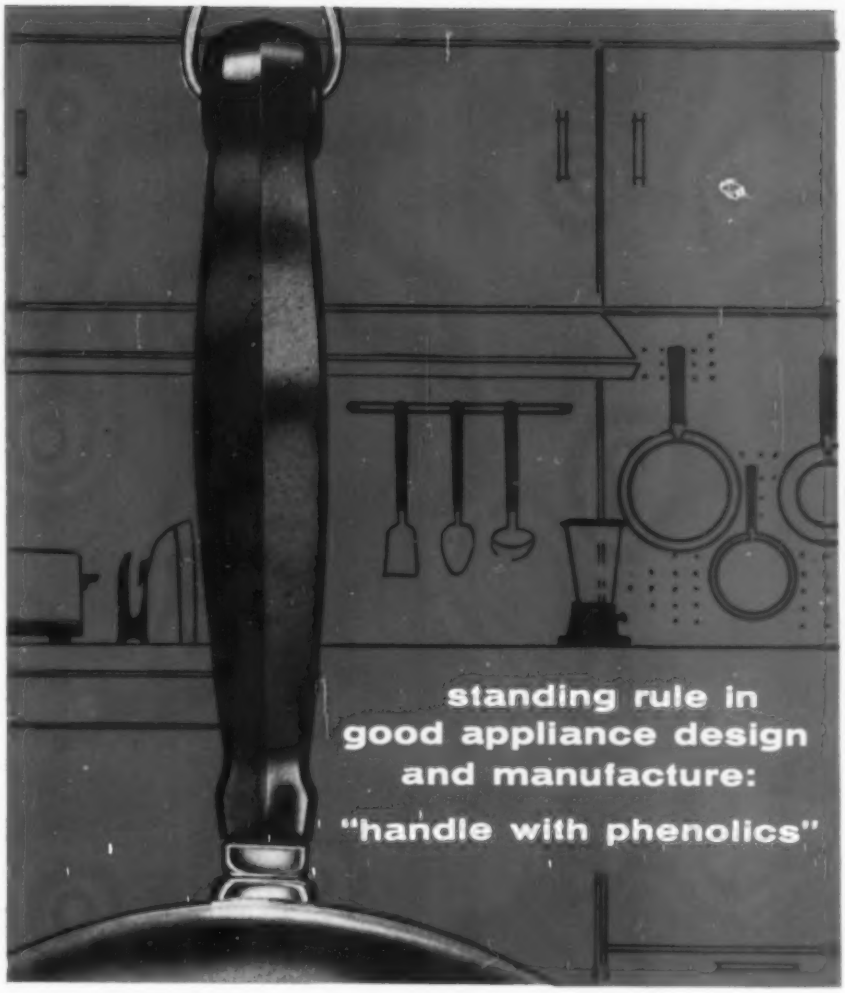
"The railroad equipment market challenges you from an economic standpoint to reduce the basic cost of the materials, as well as to provide materials which are cheaper to fabricate, easier to maintain, and capable of longer life than their competitors. It offers you a challenge to develop materials that can be made integral parts of structures. Some must be capable of being nailed and at the same time durable. They must be oil and stain proof. Fire-resistant upholstery materials are needed that will not stain, fade, or wear.

"Here is a field, which by reason of its physical characteristics or the economics involved, may not previously have been considered as being such an extensive market for plastics. We challenge you to develop new synthetics which can be offered as design materials for this equipment, and to develop means of fabricating and using them in this vast market.

"This market is not yours for the asking, but I know that you would not have progressed as you did in the past without having to fight. Sometimes this fight has been in your laboratories and research departments. At other times, it has been on design boards and production lines, and even in selling.

"Probably the greatest challenge comes from the economic standpoint, when we consider the needs of the future and the fact that we should be spending several billion dollars a year on passenger and freight cars. Since plastics permit ease of construction and maintenance, as well as longer life, some of the first costs of the material itself are minimized by the results obtained.

W. W. Patchell, Vice-Pres., Research and Development, Pennsylvania Railroad Co. Philadelphia, Pa.



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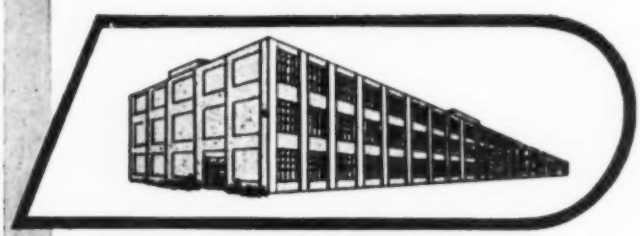

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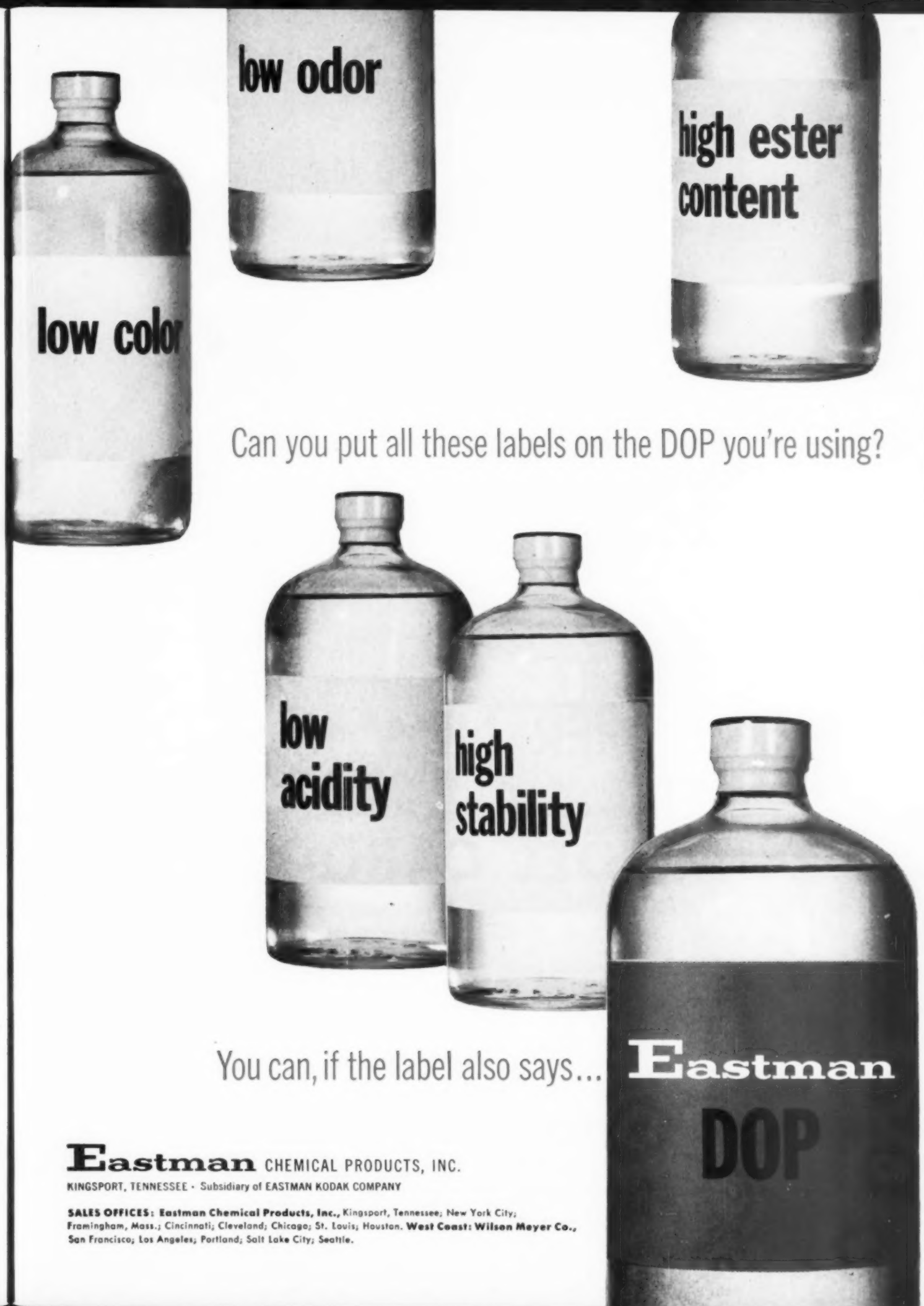

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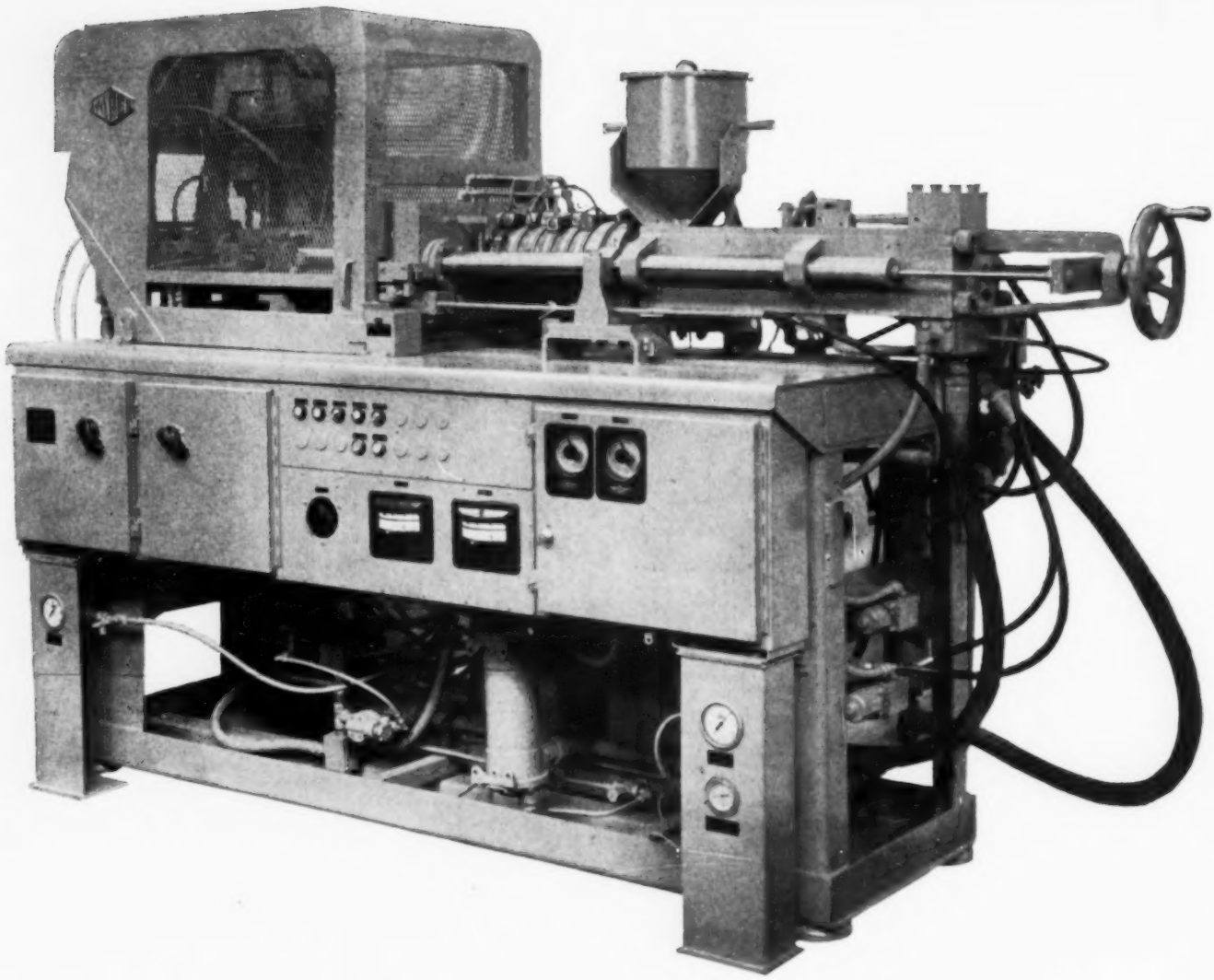

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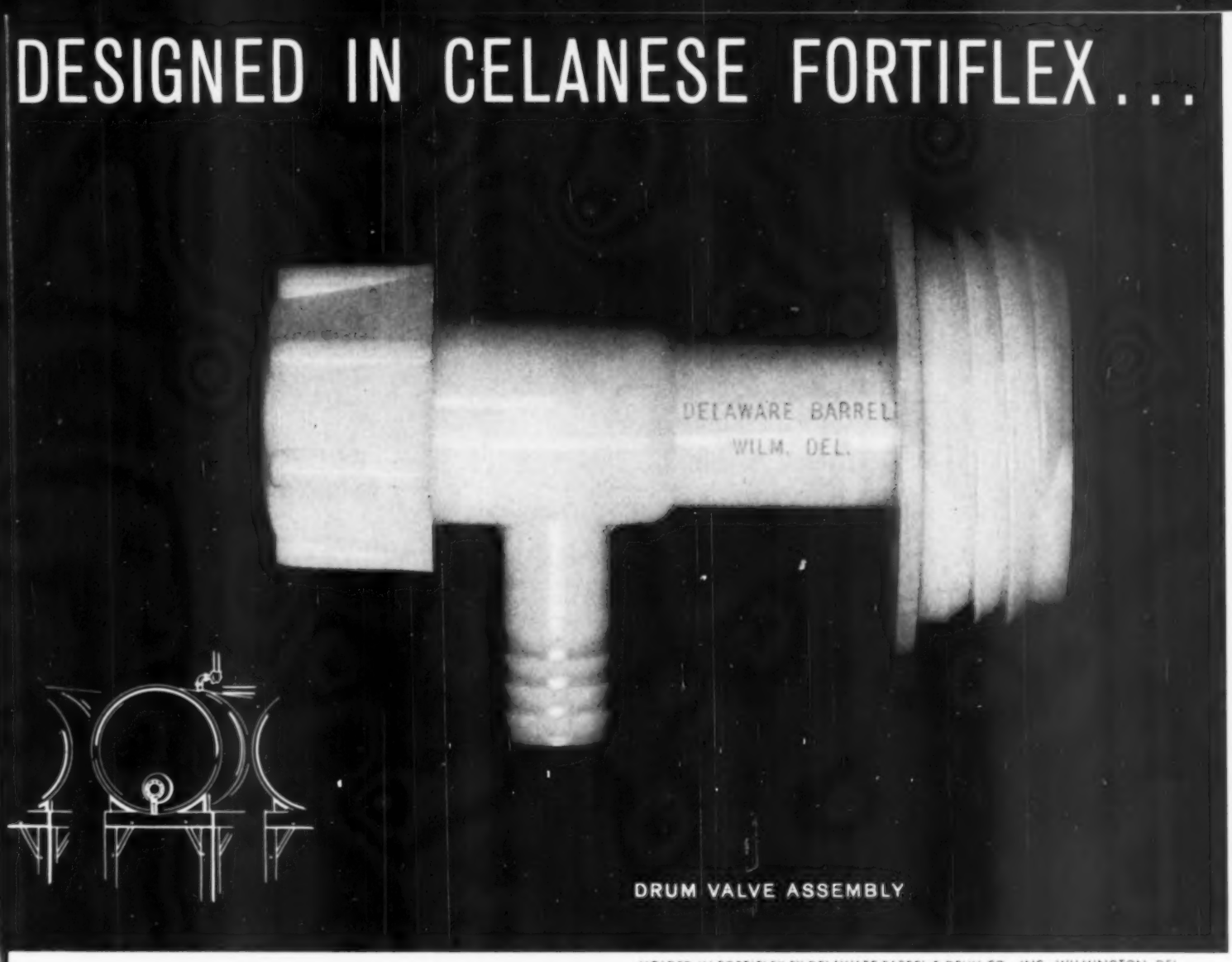

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TYPICAL PHYSICAL AND CHEMICAL PROPERTIES OF FORTIFLEX

Properties of Fortiflex "A" Related to Melt Index

PHYSICAL PROPERTIES	ASTM METHOD	UNITS	FORTIFLEX RESINS A-20	A-70	A-250	A-500
Melt Index	D-1238-52T	—	0.2	0.7	2.5	5.0
Heat Distortion Temp. (66 psi)	D-648-45T	°F.	185	185	180	180
Brittleness Temp.	D-764-52T	°F.	—200	—180	—160	—100
Impact Strength, izod (⅛" x ½" injection-molded bars)	D-256-54T	ft. lb./in. notch	23	18	13	3
Tensile Strength, Max., 0.2 in./min.	D-638-52T	psi.	3700	3600	3500	3300
Elongation, First Tensile Yield Point	D-638-52T	%	25	25	25	25

Properties of Fortiflex "A" Not Affected by Melt Index

PHYSICAL PROPERTIES	ASTM METHOD	UNITS	VALUE
Density		g./cc.	0.96
Refractive Index	D-542-50	$N^{20}D$	1.54
Hardness, Shore D	D-676-49T		65
Stiffness	D-747-50	psi.	150,000
Water Absorption (⅛" specimen, 24 hrs. immersion @ room temp.)	D-570-54T	%, wgt. gain	<0.01
Flammability	D-635-44	in./min.	1.0

Celanese Corporation of America, Plastics Division,
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PLASTICS TECHNOLOGY

AUGUST, 1958

EDITORIAL: Polyethylene Confusion is Ended!

In late 1955 and early 1956, we published a series of editorials on preventing confusion in polyethylenes resulting from the Ziegler and Phillips types of low-pressure polymers, the continued popularity of standard (or high pressure) polymers, and the coming use of copolymers of high- and low-pressure types. We concluded by urging that the entire nomenclature problem be handled by the fully-equipped, representative body, ASTM's Committee D-20 on Plastics, to arrive at the proper solution.

Now, we are pleased to announce the formation and approval of a new Tentative Specification for Polyethylene Molding and Extrusion Materials, ASTM Designation D1248-58T. The materials are given in three types having the following density ranges in grams per cubic centimeter: Type I, 0.910-0.925; Type II, 0.926-0.940; and Type III, 0.941-0.965.

At the June meeting, the following definitions were approved and are expected to receive official status at the June 1959 meeting. These definitions by Section A of Subcommittee X are as follows: Lowest Density Polyethylene—Any polyethylene having a density less than 0.910 g./cc.; Lower Density Polyethylene—Any polyethylene having a density from 0.910 through 0.925 g./cc.; Medium Density Polyethylene—Any polyethylene having a density from 0.926 through 0.940 g./cc.; Higher Density Polyethylene—Any polyethylene having a density from 0.941 through 0.965 g./cc.; and Highest Density Polyethylene—Any polyethylene having a density above 0.965 g./cc.

•

We urge and expect every polyethylene material manufacturer and processor to adopt this system of terminology and, in so doing, contribute his share in giving plastics the acceptance accorded an adult industry that is aware of its responsibilities to our world.

We're Moving Next Month

In mid-October, Bill Brothers Publications, publishers of PLASTICS TECHNOLOGY and eight other trade magazines (Rubber World, Sales Management, Sales Marketing, Tide, Premium Practice, Fast Food, Floor Covering Profits, Tires-TBA Merchandising) will move to new and larger quarters in a newly-built, air conditioned skyscraper at 630 Third Avenue, the southwest corner of 41st Street.

Bill Brothers has leased 2½ floors containing about 25,000 square feet of floor space in the newly erected, 22-story building at an aggregate rental of nearly $2,000,000.

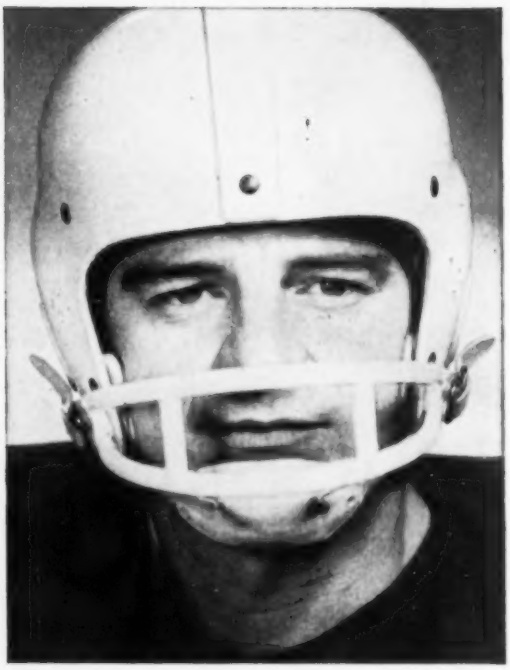
In making this move, Bill Brothers merely is doing what it has preached right along—the future looks bright indeed, and future years are much more important than current months.

Please look us up after October!

Arthur M. Merrill

Editor

"See how much easier this flexible guard goes on!" John DePaulis (left) demonstrates to John Cowden the extra benefits of the Marietta football face guard, made from Spencer Nylon.



Better vision, too. Because Spencer Nylon is metal-tough as well as plastic-light, even thin guards give good protection.

More Flexible Nylon Solves Molding Problem

Special properties of Spencer Nylon give Texas product needed extra flexibility plus metal toughness . . .

A perplexing problem recently faced Dr. M. T. Marietta, a Texas dentist and manufacturer. Dr. Marietta had a molding problem requiring a material that was both flexible *and* tough. In addition, the material had to be lightweight and easy to mold. The solution he found may help you, too.

His problem began the day that Texas Christian University's star back, Lindy Berry, broke his nose and jaw in football practice. Soon after that, Berry appeared in the office of Dr. Marietta. Berry intended to play the season out, he declared, and he wanted a protective guard for his broken bones. For this emergency, Dr. Marietta produced a hand-made face mask. With it, Berry not only played out the season, but also made All-American. This was the beginning of what is now known as the Marietta Safety Mask Co., of Dallas.

Most face guards of the past were steel, dip-coated with rubber. They were impractical and often dangerous. Guards made of other plastics were so rigid that it was often hard to pull off the helmet without practically disjointing the player's ears. Then Dr. Marietta thought of nylon. He first tried an earlier-type nylon, but found the samples still too rigid.

The final answer turned out to be new, easy-to-mold Spencer Nylon. Dr. Marietta finds Spencer Nylon flexible, lightweight and durable under playing conditions. He reports less breakage with nylon than with any other materials. With Spencer Nylon, he can make guards that are slim, smooth and attractive.

Players can see better, too, through these slimmer guards. Also, because Spencer Nylon is easy to dye, schools can have these bars dyed in their own school colors. And the superior design of the guard makes it easy to install on the helmet.

The company started to make molds for Spencer Nylon face guards in November, 1957. The first guards came off in February. By the first of May, the firm was behind in their orders. General Manager John DePaulis believes the volume may amount to 100,000 the first year. In fact, such gear may soon become compulsory for all football teams.

Your special needs may also find an ideal answer in Spencer Nylon. For complete information write: Spencer Nylon, Spencer Chemical Co., 516 Dwight Bldg., K. C. 5, Mo.

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GENERAL OFFICES: DWIGHT BUILDING, KANSAS CITY 5, MISSOURI

NEWS in BRIEF

Value of plastic and elastomeric materials sold or otherwise used in 1957 was estimated at $1.82-billion, according to the Sales Management Survey of Industrial Buying Power. This represents a 48% increase over the Census Bureau's figures for 1954, and also involves a 12% increase in employment in the plastics industry. Middlesex, N. J., county leads the country in both classifications (plastics and elastomerics) with regard to number of plants and number of employees; five and 4,100, respectively.

Prosthetic limbs and braces presents a large, current market for plastics materials (see Lee Zukor's engineering column, pages 734-5). More than one-million pounds of plastic material go into this field of application each year. A federally-sponsored research program has been active since 1947 to bring modern science and technology to bear on the problems of prosthesis. The steadily-increasing demand for lighter and more comfortable prosthetic limbs and braces is, in turn, bringing more and more demand for plastics.

Polyethylene 10-mil bags have been accepted by the Railroad Joint Classification Committee for domestic rail shipments of plastics materials. Although limited to plastics materials, the announcement is expected to pave the way for new markets with enormous potentials. The cost of the bags in large lots competes favorably with most standard shipping sacks and containers.

Serious problem in post thermoforming industry is the current shortage of talented, trained, and qualified personnel, according to consultant Gerhard Kostwzewa (see Guest Editorial, pages 732-3). To meet the need, a heavy burden falls on institutions of technology to train the manpower. In addition, the industry itself must constantly feed information and material for study to the technical institutions and centers of education from all sources that are concerned with the industry and its future welfare.

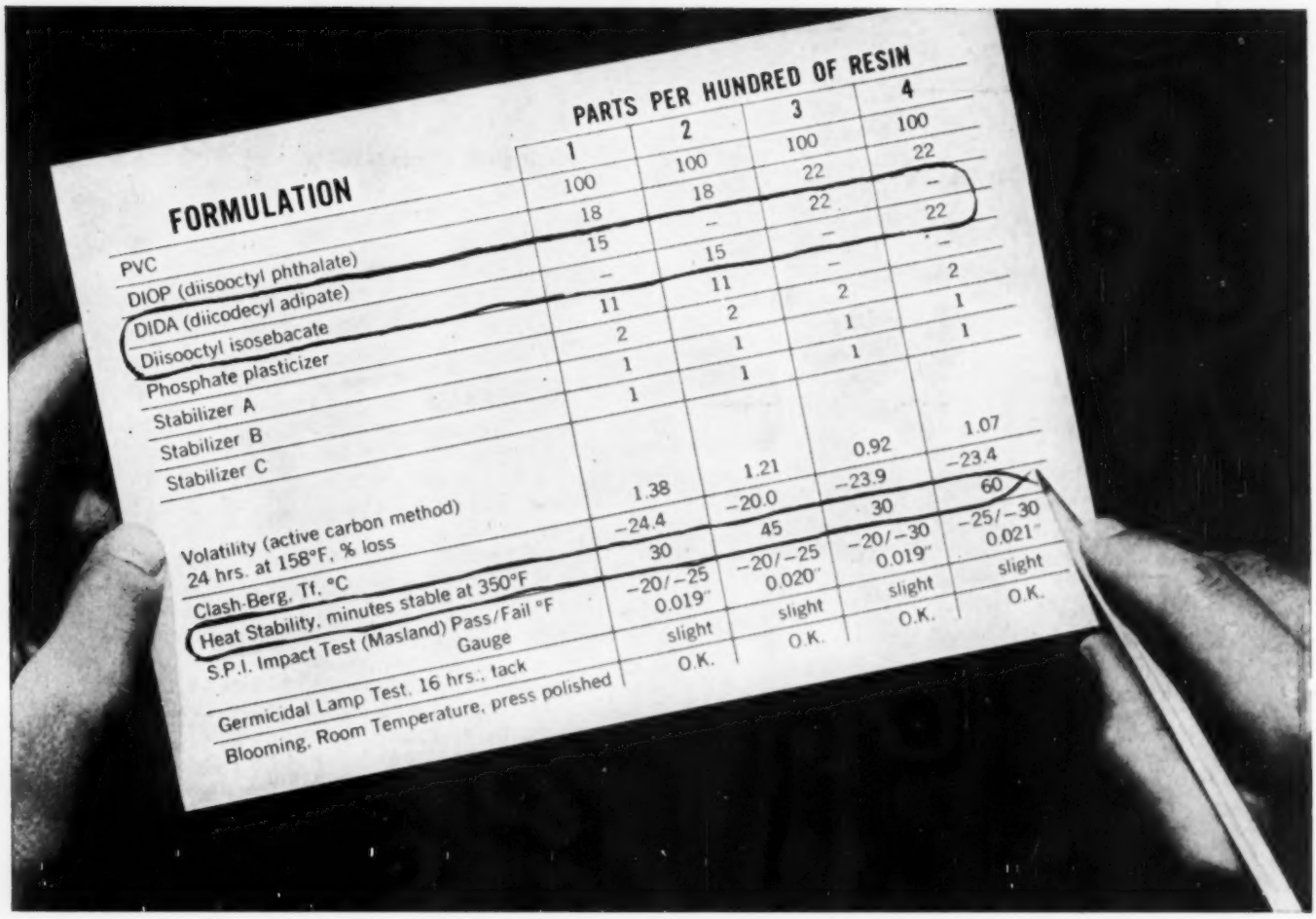
Business developments in the plastics industry displayed the usual summertime lull. Negotiations are being completed for a merger of Harshaw Chemical and Kentucky Color & Chemical, where the latter will operate as a separate subsidiary corporation. In the first step in a diversification program, National Tool purchased Auto-Vac Co., which will continue to operate as an independent division of the new owner.

Company expansions in plastics showed the seasonal slow-down in number. Construction is underway on the $1-million maleic anhydride plant for American Cyanamid at Bridgeville, Pa. Cyanamid also plans to build a multi-million dollar anthroquinone plant in Bound Brook, N. J. Petro-Tex Chemical's new isobutylene plant at Houston, Tex., is scheduled for completion this December. Reichhold Chemical has begun building a $1-million terminal on the ship channel at Mobile, Ala., to handle coastal barges and ocean-going vessels.

New Materials to be noted (see pages 748-50): ultra-violet stabilizer; synthetic copolymer adhesive; thermosetting acrylic finish; two liquid parting agents; vinyl-acrylic copolymer sizing emulsion; neoprene adhesive for heat-resistant phenolic resins; two fluoroalcohols as plastics intermediates; PVC polymer for plastisols and organosols; fast-grab adhesive; three mold releases; and a non-flammable solvent.

New Equipment worthy of attention (see pages 751-4): hopper-loader attachment; pre-expander for polystyrene; double-arm continuous mixer; automatic sheet feeder; barrel finishing machines; and testing instruments for arc- and tracking-resistances.

Plastics Applications of special interest (see pages 756-7): reinforced plastic cabinets for portable television sets; wire varnish-enamel systems; transparent acrylic canopies for basement window wells; color-coded Teflon tapes; pipeline insulators of glass-reinforced polyester; and polyethylene shipping containers for corrosive liquids.


FORMULATION
PARTS PER HUNDRED OF RESIN
1 2 3 4
PVC 100 100 100 100
DIOP (diisooctyl phthalate) 18 18 22 22
DIDA (diicodecyl adipate) 15 – – –
Diisooctyl isosebacate – 15 – –
Phosphate plasticizer 11 11 22 22
Stabilizer A 2 2 2 2
Stabilizer B 1 1 1 1
Stabilizer C 1 1 1 1
Volatility (active carbon method) 24 hrs. at 158°F, % loss 1.38 1.21 0.92 1.07
Clash-Berg, Tf, °C –24.4 –20.0 –23.9 –23.4
Heat Stability, minutes stable at 350°F 30 45 30 60
S.P.I. Impact Test (Masland) Pass/Fail °F –20/–25 –20/–25 –20/–30 –25/–30
Gauge 0.019" 0.020" 0.019" 0.021"
Germicidal Lamp Test, 16 hrs.; tack slight slight slight slight
Blooming, Room Temperature, press polished O.K. O.K. O.K. O.K.

This test shows

HEAT STABILITY OF PLASTICIZED VINYLS IS IMPROVED BY ESTERS OF ISOSEBACIC® ACID

ISOSEBACIC® acid, a new synthetic 10-carbon dibasic acid, has many plus values that recommend it as an intermediate for vinyl plasticizers. You'll see one example in the above figures—results of a test made recently by a processor of vinyl plastic film.

Read down columns 1 and 2. *Heat stability improves 50%* (from 30 minutes to 45 minutes) when 15 parts of an ISOSEBACIC acid ester replace 15 parts of an adipic ester in this formulation.

Read down columns 3 and 4 and you see an even more striking result in a test where higher ester levels were used. ISOSEBACIC acid ester actually *improves heat stability 100%* (from 30 minutes to 60 minutes).

Among the plus properties of ISOSEBACIC acid esters as vinyl plasticizers are:

- Low color
- Low odor
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And ISOSEBACIC acid has other uses in the plastics field. It can be used as an intermediate for polyamides, polyesters, polyurethanes and alkyd resins. If you make any one of them—or a vinyl plasticizer—it will pay you to evaluate U.S.I. ISOSEBACIC acid. Send today for data sheets and samples.

CHEMICAL PROPERTIES

ISOSEBACIC acid is a mixture of C-10 dibasic acids—2-ethyl suberic; 2,5-diethyl adipic; and sebacic. It undergoes typical reactions of dibasic acids. It yields acid and neutral esters, acid and neutral salts. Relatively stable, it is not oxidized by air at ordinary temperatures.

PHYSICAL PROPERTIES

Molecular weight	202.24
Combining weight	101.12
Density (80°C)	1.025 g/ml
	8.55 #/gal
Melt viscosity (80°C)	78.5 centipoises
Specific heat of vapor (226°C)	0.34 cal/g (est.)
Heat of vaporization (226°C)	107 cal/g
Specific heat of solid (24°C)	0.33 cal/g
Heat of Combustion	1296 K cal/mole
Flash point (closed cup)	430°F.
Ionization constant at 25°C.	$K_1 = 3.5 \times 10^{-3}$
	$K_2 = 5.1 \times 10^{-5}$

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In the photos above you see a completed plastic stretch die and the laminating build-up stage in its fabrication.

This plastic stretch die has excellent dimensional stability. It is lightweight and was produced fast at low cost.

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Keeps electrical stability.
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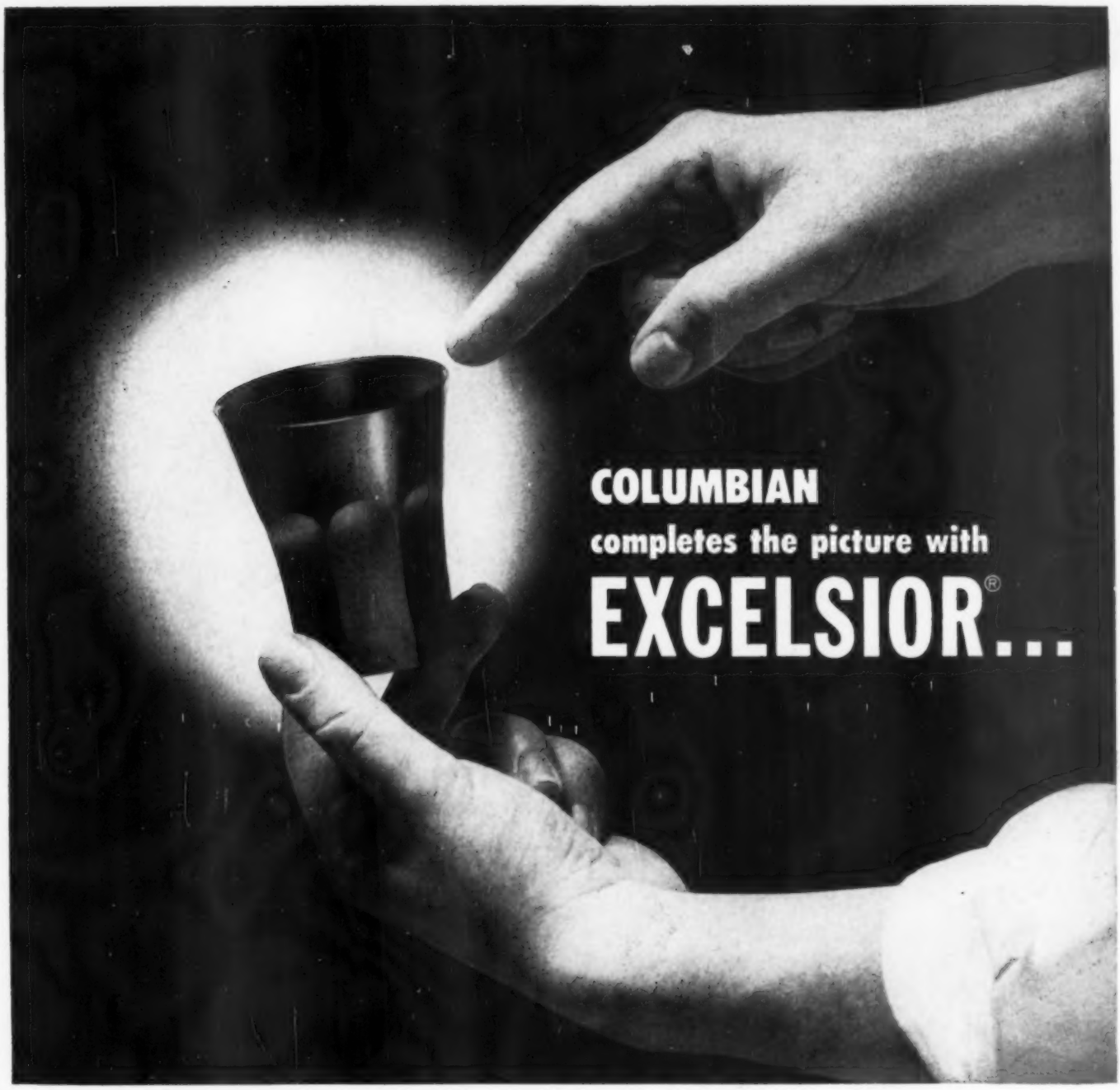

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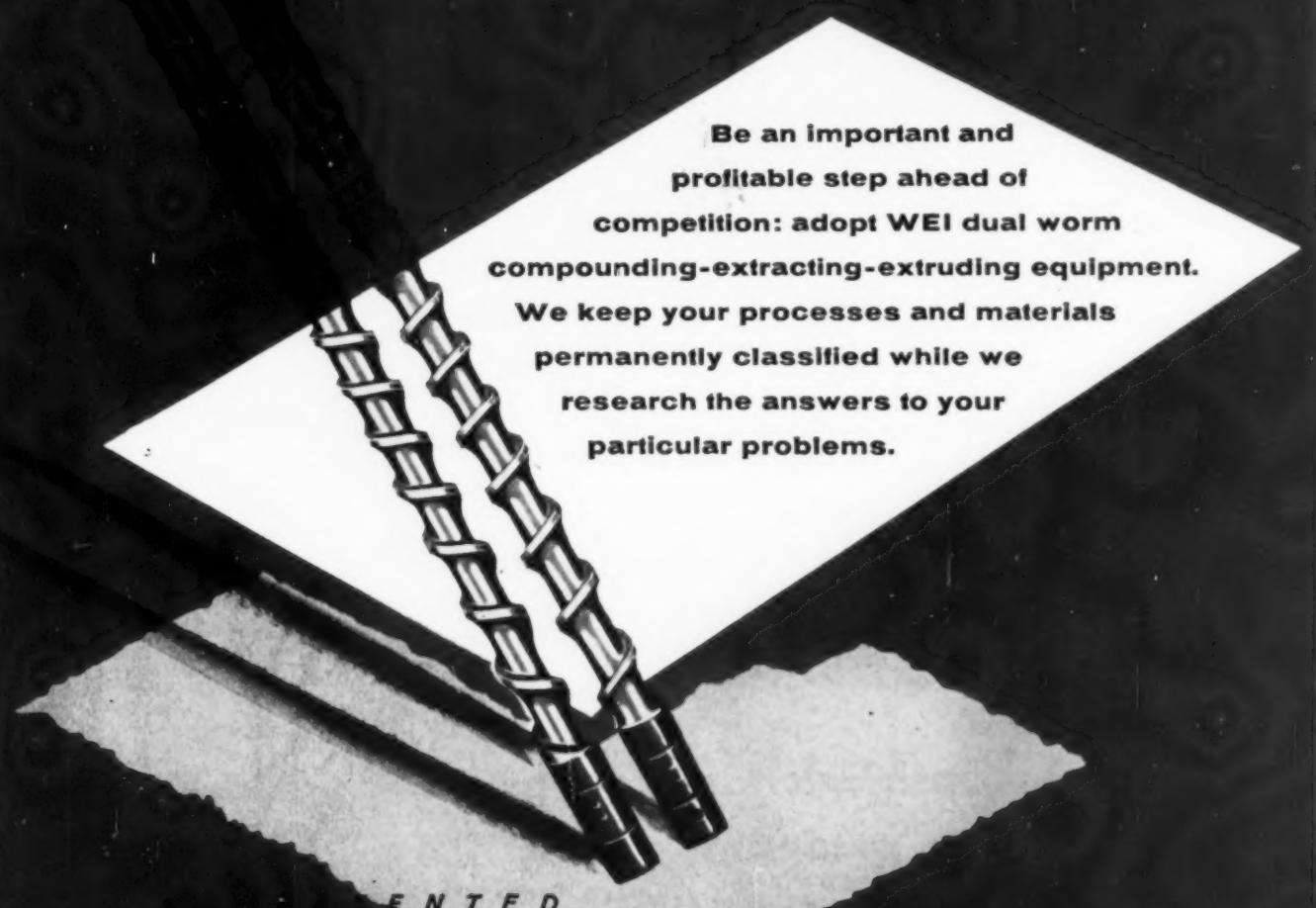

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PLASTICS
TECHNOLOGY

Extrusion of Rigid Polyethylene Pipe

Extrusion conditions are discussed, with major emphasis on post-extrusion sizing techniques, and mention is made of suggested applications.

L. B. CROLEY, *Comm'l Devel. Engr.,*
and
ROBERT DOYLE, *Group Leader, Extrusion & Calendering Section, Sales Service Lab.,*
Phillips Chemical Co.
Bartlesville, Okla.

THERE are available on the market today several types of polyethylenes. Basically, these polyethylenes are made by three processes: the high-pressure process discovered in 1933 in England; the organometal processes receiving attention in the United States and other countries (the more publicized of which have been the Ziegler process in Germany and the Natta process in Italy); and the Phillips process developed in this country and which commenced commercial production in 1957. Each of the three processes is used to produce a variety of materials. Furthermore, there are other materials in the offing made not only by the methods mentioned, but also by different techniques. The subject of polyethylene has become complex indeed.

The differences among the basic types of polyethylene that are widely available today result primarily from differences in molecular configuration. At one end of the scale is conventional polyethylene which has a highly-branched molecular configuration; on the other end of the scale is the Phillips-type Marlex® polyethylene which has essentially no branching and, consequently, is a highly-linear polyethylene. The organometal catalyzed material is intermediate approaching the linear end of the scale.

Because of the molecular structures, the properties of the various materials differ significantly. The property most easily observed is that of greater rigidity of products fabricated from linear materials. In addition, other properties that increase with increasing linearity are:

(1). Tensile strength;
(2). Heat resistance (the material is steam sterilizable);
(3). Chemical resistance (oil and grease resistant;
(4). Abrasion resistance (approaches that of nylon); and
(5). Impermeability to gasses and liquids.

Pipe and tubing fabricated from Marlex polyethylene are rigid and usually supplied in 20-foot lengths. In smaller diameters, below one inch, the tubing can be coiled. For outdoor applications, as with all polyethylenes, the material can be made resistant to ultraviolet light by well-dispersed carbon black and antioxidant.

The subject of rigid polyethylene pipe certainly is too broad for all phases to be covered in this article. This discussion, therefore, will be limited primarily to extrusion and sizing techniques. These techniques and methods to be discussed are applicable to other poly-

Revised from a paper presented originally at the Annual Technical Conference, Society of Plastics Engineers, Inc., Detroit, Mich., Jan. 29, 1958.

Leo B. Croley was born in Bartlesville, Okla., in 1925. He attended Iowa State College, receiving a B.S. in Chemical Engineering in 1946. After graduation, he joined Esso Standard Oil in 1946 and worked in process design and technical service. He went with Phillips in 1952, and has worked with the company's plastics materials in pilot plant, market development, technical service, and commercial development activities. He is a member of SPE, ACS, and AIChE. Mr. & Mrs. Croley and their five children (all sons) live in Bartlesville.

Robert Doyle was born in Boston, Mass., in 1921, and received his B.S. in Chemical Engineering from Northeastern University in 1943. He joined Phillips in 1956, after having been previously with Monsanto, Celanese, and several smaller concerns in the plastics industry. The 15 years since his graduation have been devoted to research, development, and production in the thermoplastics field, specializing in extrusion and the converting or fabrication of extruded products such as film and sheeting. He is an active member of SPE and ACS. Mr. & Mrs. Doyle have four children, and make their home in Bartlesville.

ethylenes and most other types of thermoplastics, as well as rigid polyethylenes. The material that we are most qualified through experience to discuss in detail is Marlex polyethylene, and information in the following text refers to that material.

Extrusion Conditions

For any material to be widely useful and profitable to plastic pipe and tube fabricators, it must be simple to extrude. Rigid polyethylene is extruded easily using conventional extrusion equipment ranging from the early short-barrel machines to the new machines having a 20:1 or greater barrel length-to-diameter ratio.

Polyethylene is very resistant to water, thereby requiring no drying prior to use. However, all should be aware of surface condensation that will occur when bringing pelleted material from a cold storage area to warm production rooms. Black polyethylene often is used for pipe and tubing applications. Since carbon black has a strong tendency to absorb water, hopper driers or drying prior to extrusion of black material is recommended for best results.

Screw type is not critical. Most commonly, a nylon- or polyethylene-metering screw with 4:1 compression ratio is used. Water cooling of the screw is not necessary, and seldom is used. To maintain back pressure for extrusion, an 80-20 screen pack is used with good results. It should be noted that a wide variety of screen packs have been demonstrated to be satisfactory.

The die design for a satisfactory product depends greatly on the sizing technique employed. Sizing technique and die design will be discussed in more detail later in this article. However, here it is well to point out that the configuration of the entry to the die should be streamlined, and that straight-through or offset dies both are satisfactory.

Because of the high softening temperature, rigid polyethylene usually is extruded at a stock temperature at the die between 400-450° F. for the best overall results. Temperatures across the extrusion machine range from 300-350° F. at the hopper section and up to 400-450° F. at the die. Extruding with a stock temperature down to 375° F. has resulted in poor weldline strength both in offset and straight-through dies. Both good part strength and good production rates have been demonstrated with a 425° F. stock temperature at the die.

Sizing Techniques

Getting a plastic material to flow uniformly from the die usually is rather easy, but that is only one phase of the problem. Maintaining shape and size upon cooling often is the major problem. Rigid polyethylene has been extruded with varying degrees of success using the common sizing techniques of extended internal mandrel, sizing rings, and vacuum-sizing methods.

Of all the techniques tried, the cooled external-sizing tube with internal air pressure appears to be the easiest method for maintaining the size and shape of Marlex tubular goods. This method gives a product having a smooth inside diameter that is important to flow characteristics. Likewise, the product outside diameter has a smooth and slick surface that is unmarked by water. Figure 1 shows a sizing tube that is fastened directly to the die and separated only by an insulating gasket made from a material such as Teflon. Figure 2 gives a cross-sectional view of the sizing tube and die.

One of the prime functions of the sizing tube is the removal of sufficient heat from the extrudate so as to set a skin on its surface. Therefore, the sizing tube should be made of material having high thermal conductivity. Sizing tubes have been made of copper, brass, and, most commonly, aluminum. The wall thick-

ness of the sizing tube should be sufficient to permit routine handling in the shop without damage. A wall thickness between ⅛-¼-inch usually is satisfactory.

The dimensions of the sizing tube are important to finished product size and the production rate. The inside diameter of the sizing tube is held constant over its length, and should be slightly larger than the desired outside diameter of the finished product in order to allow for shrinkage of the material as it cools. The amount larger that the sizing tube should be is dependent to some degree on the variables that affect shrinkage, such as (1). extrusion temperature; (2). wall thickness; (3). extrusion rate; and (4). diameter. The inside diameters of sizing tubes usually are 2-4% larger than the outside diameters of the finished products.

The shrinkage on cooling of thick sections is greater than thin sections. Therefore, heavy-wall tubing will have a slightly smaller outside diameter than thin-wall tubing when both are made in the same sizing tube. However, by adjusting the take-off rate while maintaining constant extrusion conditions, the wall thickness of the finished product may be varied over a wide range both larger and smaller than the die opening without greatly changing the outside diameter of the product. For example, from a die for schedule 40, two-inch pipe that has a wall thickness of 0.154-inch, tubing with a wall thickness from 0.060-0.600 inch has been made. Even these did not represent a limitation, but do serve to illustrate the versatility of the outside diameter sizing technique as far as die dimensions are concerned. This offers the extruder the advantage of lower tooling costs by using existing dies and blowing-up the extrudate into a sizing tube of proper dimensions.

Under specified conditions of cooling-water rate and temperature, the length of the sizing tube determines how fast the outside wall of the pipe can be set. This, in turn, governs the production rate of specification product. The longer sizing tube provides more cooling surface, thereby permitting higher extrusion rates. Thick-wall tubing requires more cooling surface of a longer sizing tube than does thin-wall tubing.

The die dimensions are important to obtain the desired product dimensions, but not as important as in some other techniques. As a matter of fact, the external-sizing technique permits wide versatility in die dimensions that may be used to produce a specified product. Basically, the die is smaller than the finished product. By use of air pressure the extrudate is blown up into the sizing tube. The amount of blow up that has been used ranges from 5-20%; that is, the inside diameter of the die bushing is 5-20% smaller than the desired outside diameter of the product.

The wall thickness of the extrudate at the die or the area bounded by the outside diameter of the mandrel and the inside diameter of the bushing is much more important with small size tubing; smaller than ¾-inch outside diameter. Since the extrudate is blown to a larger outside diameter in the sizing tube, the wall tends to become thinner (assuming that the material is being taken away from the die at the same rate at which it comes out of the extruder).

As mentioned previously, one of the functions of the sizing tube is to provide heat-exchange surface between the hot extrudate and the cooling medium (most commonly, tap water). The water may be cascaded over the sizing tube, as shown in Figure 3; the sizng tube may be jacketed; or the tube may be submerged under water. The simplest and most common of these is the cascading of water over the tube. The sizing tube may be jacketed easily and simply by using a larger tube and 0-rings, as shown in Figure 4

While tap water normally is used for cooling, colder water is even better. In the summertime, particularly when the tap water tends to be rather warm, the production rate can be limited by lack of cooling. It was stated earlier that for a given cooling-water rate and temperature, the length of the sizing tube

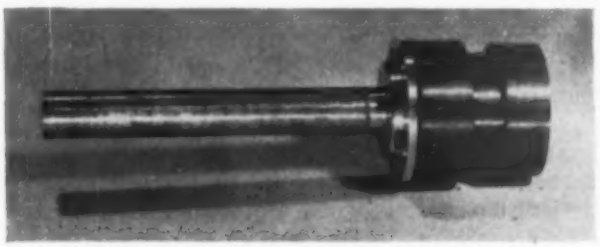

Fig. 1. External sizing die that is fastened to the die face for the extrusion of tubular goods.

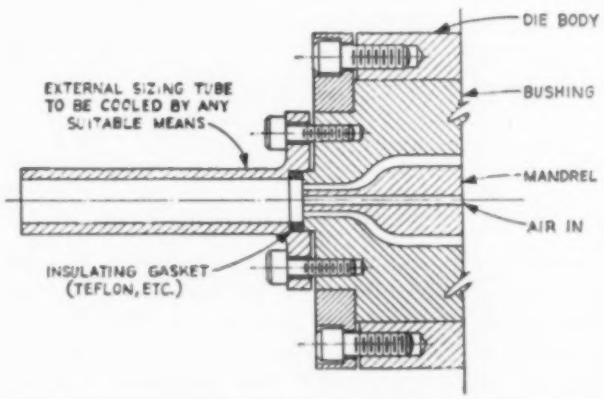

Fig. 2. Cross-sectional view of external sizing tube for extrusion of plastic pipe.

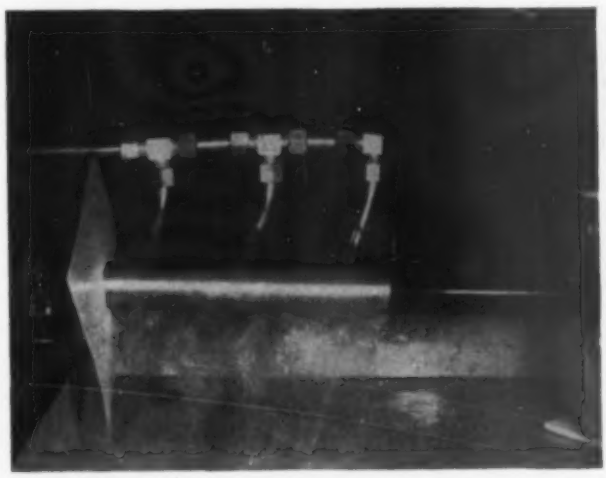

Fig. 3. Water cascades for cooling extrusion sizing tube. Shield (left) prevents the cooling water from splashing on the hot extruder die.

determined the production rate. The corollary also is true; for a given length of sizing tube, the water rate and temperature will affect the production rate. Colder water causes the surface of the plastic tube to be set more rapidly and deeper into the tube wall. Cooling downstream from the sizing tube is accomplished satisfactorily by either cascading water over the pipe or by a water bath that is circulated sufficiently to prevent the water from heating.

Internal air pressure is an important factor, and must be high enough to push the hot extrudate against the cold surface of the sizing tube with sufficient force to smooth the extrudate surface. The amount of pressure required is affected by several variables, such as extrusion temperature, amount of blow-up, diameter, and wall thickness. For two-inch schedule 40 pipe (0.154-inch wall) extruded at a stock temperature of 425° F. with 12% blow-up, the internal air pressure is approximately 20 psi.

It is important that the air pressure be maintained constant and regulated to minimize fluctuations from the air source. The air is put into the plastic tube through a spider leg on a straight die, and through the back of an off-set die. The air hole in the mandrel usually is about 3/32-inch in diameter.

At first thought, one of the problems with the external-sizing method would appear to be that of maintaining the internal air pressure when the pipe is cut to length. The following five methods have been used to hold the pressure in the pipe:

(1). Plugging the end with a tapered plug made of wood or other suitable material.
(2). Clamping.
(3). Using a dip leg filled with suitable fluid.
(4). Inflated bellows.
(5). A saw that will cut and seal simultaneously against the internal air pressure.

Plugging the end has been used successfully, and affords the major advantage of simplicity. On the other hand, however, this method also presents the following disadvantages: danger of the plug blowing out; limiting the production rate because of the air pressure being off for short intervals while the pipe is cut and replugged; and high scrap losses. While the polyethylene scrap may be reused if kept clean, it is necessary to scrap about 12-inches of tube length because of plugging after each cut.

Fig. 4. Jackets for sizing tube are made with O-ring seals. Note Teflon gasket in recess of flange.

Clamping also is simple, and is preferred over plugging because the first two disadvantages listed above are eliminated. The clamping of small-diameter and thin-wall tubing can be accomplished easily by a variety of methods. To clamp heavy-wall and large-diameter pipe, however, a rugged device is needed for rigid polyethylene because of its toughness.

An inflatable bellows would appear to have a great deal of merit, and is used by a very competent and potentially-large fabricator of plastic pipe and tubing. We have not investigated this technique.

Another very desirable method of maintaining air pressure is a saw that cuts the pipe to length and seals the internal pressure during and after the cutting. This type of saw is in the development stage, and is not available commercially as yet. It is apparent that two saws are required for this method, and the pipe may be cut to any desired length. Very short lengths become more of a problem, however, and might be solved more economically by a cutting operation subsequent to extruding, rather than by an in-line cutter.

Profitable production rates are obtainable when using the external-sizing technique. For example two-inch schedule 40 pipe has been extruded from a 2½-inch NRM extruder at the rate of 90-100 pounds per hour. Tubing ⅜-inch in diameter with a 35-mil wall has been produced at the rate of 35 feet per minute while staying below a head pressure of 5,000 psi. Tubing with ¾-inch outside diameter and ⅛-inch wall has been run at 720 feet per hour.

The major points in the use of the external sizing technique for rigid polyethylene have been discussed. The proper sequence for putting the variables into operation can simplify greatly the start-up procedure. There are two basic ways that offer an easy and satisfactory start-up. These are starting for the first time with a new size, and starting with a length of previously-extruded tubing stuck into the sizing tube and extending through the draw rolls.

In starting for the first time, the following steps are used:

(1). Fasten the sizing tube to the die..
(2). Start the water on the sizing tube so that it is completely covered with a generous supply. To prevent splashing on the die in case of unjacketed tubes a suitable shield of plastic, metal, or rubber can be used at the die-end of the sizing tube (as shown in Figure 3).
(3). Set the air pressure about two-thirds of the required value. Since the required value is somewhat of an unknown in starting for the first time, 10 psi. is a fair starting point for ½-inch diameter and larger tubing with 60-mil and greater wall thicknesses.
(4). Start the extrusion machine at about 25% of the expected or desired rate.
(5). The extrudate will flow through the sizing tube with the end open and air escaping. Until the plastic tube is led through the draw rolls, the end is left open.

(Continued on page 731)

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Adhesive Bonding of the Newer Plastics

Results of an investigation of adhesives and pretreatments are given for Cymac 325, Delrin, diallyl phthalate, Lexan, Marlex 50, Grex Polyolefin, Moplen, Multrathane, and Penton.

THE introduction and increasing availability of the newer plastics requires that information on adhesive bonding of such plastics be available. In general, the newer plastics combine several desirable characteristics that make them suitable for many utilitarian uses. In such uses, adhesive bonding of the plastic parts to other parts, whether of plastic, metal, glass, or other materials, often is either necessary or desirable.

Adhesive bonding to the following plastics was investigated: Cymac 325, Delrin, diallyl phthalate (Orlon-filled), Grex Polyolefin, Lexan, Marlex 50, Moplen, Mutrathane, and Penton (1).*

All polyethylene specimens used in this investigation were treated with concentrated chromic acid to improve their surface bonding properties. This work is a continuation of a similar investigation conducted on low-density polyethylene and reported previously (2). It was of particular interest to determine whether or not the rate of oxidation of the less branched, high-density polyethylenes would be slower than that of the highly branched, low-density polyethylene. Shear strength tests were run on both types of polyethylenes after treating them with chromic acid at room temperature and at 160° F.

A few adhesive-bonded tensile specimens of Marlex 50 also were tested to determine the magnitude that can be expected when the bonded joint is subjected to tensile stresses. Delrin, Moplen, Penton, and Cymac 325 were evaluated for tensile strength adhesion, while Lexan and Multrathane were tested for shear strength adhesion. The adhesive bonding of Orlon-filled diallyl phthalate to itself was investigated by means of shear tests conducted over a temperature range from —65 to +160° F.

The adhesive evaluated, except those used with diallyl phthalate, essentially were solventless, contact-pressure, room-temperature curing types.

*Numbers in parentheses refer to Bibliography at end of article.

Test Procedures

A preliminary evaluation of glossy, unsanded, untreated Orlon-filled diallyl phthalate that had been prewiped with acetone, and then bonded to itself, showed poor adhesion properties of the plastic surface. Lap shear specimens were prepared using polysulfide-modified epoxy, styrene-polyester, and furane-type adhesives. All specimens demonstrated very poor bond strength when tested manually under application of either torsional shear or cleavage stresses. A duplicate set of specimens that had been presanded, was prepared with the same adhesives and tested in the same manner. The bond strengths of all these specimens was good.

Shear specimens then were prepared utilizing strips of the diallyl phthalate, one by three by ⅛-inch in size. The plastic was bonded to itself, using a ½-inch overlap in each case. Five specimens were prepared for each variation in adhesive, pretreatment method, and test temperature. The adhesives evaluated included: a polysulfide-epoxy resin cured with diethylene triamine; a furane resin based on furfural alcohol and furfuraldehyde that was cured with monochloromaleic anhydride; and a styrene-polyester resin mixture of rigid and flexible resins catalyzed with methyl-ethyl ketone peroxide. All were cured at room temperature.

Elevated-temperature curing adhesives used were a diallyl phthalate partial polymer in solvent solution, and a diallyl-phthalate modified polyester resin. The mating surfaces of all the panels were presanded and then acetone-wiped prior to bonding. One set of sanded panels also was treated with chromic acid for two minutes at room temperature, thoroughly rinsed with water, then air-dried prior to bonding with the polysulfide-epoxy adhesive. This was done in order to ascertain whether or not a chemical etching of the surface could be effected that would enhance the adhesion qualities of the surface over that of mechanical abrasion alone.

Tensile shear tests were conducted at a rate of load application of 600-700 psi. per minute, in accordance with Federal Test Method Standard No. 175, Method 1033. This test method was followed on all subsequent shear tests on the various plastics. All tensile tests were conducted at the same rate of load application and in accordance with Federal Test Method Standard No. 175, Method 1011.1. Five diallyl phthalate shear specimens of each adhesive and surface treatment variation were tested at each of the test temperatures: —65, +73.5, and +160° F.

Delrin, Penton, and Cymac 325 tensile specimens were prepared by sandwiching a disc of the test material, 1.130-inch in diameter by ⅛-inch in thickness, between two steel tensile pieces. The tensile pieces are those described in Federal Test Method Standard No. 175, Method 1011.1. All aluminum and steel specimens used throughout the investigation were cleaned by prewiping with an acetone-dampened cloth and then vapor degreasing with perchloroethylene. The Delrin and Penton specimens were prewiped with acetone, while the Cymac 325 was prewiped with ethanol.

Three specimens of each plastic were prepared for each adhesive evaluation. Adhesives evaluated were a styrene-polyester resin, polysulfide-epoxy, urethane prepolymer, resorcinol-formaldehyde, and a cyanoalkyl-acrylate. An amine primer was applied to the adherend surfaces 30 seconds prior to bonding with the acrylate. The Delrin specimens were also tested by presanding one set of three as per the manufacturer's recommendations, then bonding with the polysulfide-epoxy. A furane resin was also evaluated for bonding Delrin. Penton and Delrin were evaluated further by bonding chromic-acid pretreated discs with the polysulfide-epoxy adhesive. Metal primers were used when bonding with resorcinol-formaldehyde adhesive. All adhesives were cured at room temperature prior to testing at room temperature.

Three Lexan shear specimens were prepared for each test variation using strips measuring four by ¾ by ⅛-inch in size that were bonded to steel panels, measuring four by one by ⅛-inch, using a ½-inch lap in each case. The Lexan was rewiped with ethanol. Adhesives evaluated were room-temperature curing polysulfide-epoxy, cyanoalkylacrylate, urethane prepolymer, styrne-polyester resin, and resorcinol-formaldehyde. The only elevated-temperature curing adhesive to be tested was an epoxy cured with phthalic acid anhydride. All specimens were tested at room temperature, as were the remaining plastics to be discussed below.

Grex Polyolefin and Marlex 50 high density polyethylenes were evaluated for bond strengths in shear. The polyethylene strips were pretreated by immersing them in a solution of the following composition, in parts by weight: concentrated sulfuric acid (sp.gr., 1.84), 1500; distilled water, 120; and potassium dichromate, 75. The polyethylene strips were immersed in the solution for measured time periods at the desired temperature. All treated parts then were rinsed with large volumes of cold running tap water immediately on removal from the acid solution, and dried at room temperature.

Shear-strength specimens were prepared by bonding strips of treated polyethylene, four by one by 0.125- or 0.072-inch to steel panels measuring four by one by 0.125-inch in size. The Marlex 50 was 0.125 inch thick while the Grex Polyolefin was only 0.072 inch thick. A lap joint of ½ inch was used for each specimen. Seven Grex Polyolefin and eight Marlex 50 specimens were prepared for each time-temperature treatment variation, and a polysulfide-epoxy adhesive was used for bonding all specimens. Times of immersion in acid at room temperature ranged from instantaneous (less than two seconds) to 24 hours. Times of immersion at 160° F. ranged from instantaneous to 10 minutes. All specimens were cured and tested at room temperature.

Marlex 50 tensile specimens were prepared utilizing polyethylene discs and aluminum tensile pieces similar to those used for the plastic tensile specimens described above. Chromic-acid pretreatments of the polyethylene for one hour at room temperature and from instantaneous (less than two seconds) to five minuts at 160° F. were evaluated for improving the adhesion properties of the plastic surfaces. Polysulfide-epoxy adhesive again was used and cured at room temperature. Three specimens were prepared for each treatment variation and tested at room temperature.

Moplen tensile specimens consisting of polypropylene discs sandwiched between aluminum tensile pieces were

prepared. Chromic-acid pretreatment of the polypropylene was evaluated for improving the adhesion properties of the plastic. Treatment times were one hour at room temperature, and one second, one minute, and five minutes at 160° F. A set of specimens pretreated for one minute at 160° F. was stored at 160° F. for seven days after bonding. This was done to determine the affect of accelerated aging on the bond strength of the acid-pretreated polypropylene. Three specimens of each test variation were prepared, using a polysulfide-epoxy adhesive. A set of untreated polypropylene specimens also was prepared for use as a control comparison. All specimens were treated at room temperature.

Multrathane shear specimens were prepared utilizing strips, four by one by ⅛-inch in size. The plastic was bonded to itself with a ½-inch lap in each case, and three specimens were prepared with each adhesive tested. An acetone-prewipe was used on each strip prior to adhesive application. The adhesives included a polysulfide-epoxy, styrene-polyester, resorcinol-formaldehyde and a urethane prepolymer. All specimens were cured and tested at room temperature.

Test Results

A summary of the best bond strengths available with each type of plastic investigated is shown in Table 1. The adhesive used and the treatment recommended are given in each case. Results for each type of plastic are described below. Details of bonding procedures are given in the Test Procedure section of this article.

Cymac 325

Cymac 325 was bonded with a urethane prepolymer, the resultant tensile strengths noted as being up to 1,137 psi., but the scatter of the data was wide. Consistently good tensile strengths near 870 psi. were obtained when bonding with styrene-polyester adhesive. Good bond strengths of styrene-polyester adhesives to polymethylstyrene would be predicted because of their structural similarity to polystyrene which is bonded readily by these adhesives. Alkylcyanoacrylate and polysulfide-epoxy adhesives gave bond strengths of 750 and 487 psi., respectively. No adhesion was evidenced with the resorcinol-formaldehyde.

Delrin

A tensile strength of 817 psi. was obtained when bonding Delrin to steel with the urethane prepolymer adhesive. Bond strengths of 651 and 610 psi. were obtained when bonding with polysulfide-epoxy and styrene-polyester adhesives, respectively. Failure occurred at 160 psi. with the alkylcyanoacrylate adhesive, and at 65 psi. when bonding with the furane adhesive. Resorcinol-formaldehyde gave no adhesion to Delrin.

Bond strength was improved tremendously by pretreating the Delrin surface with concentrated chromic acid for 10 seconds at room temperature, washing thoroughly with tap water, and air drying. The treated surface appeared etched and an odor of formaldehyde was detectable. The treated Delrin when bonded with the polysulfide-epoxy gave resultant tensile strengths up to 2,260 psi. Delrin that had been presanded with No. 240 emery cloth, but not acid treated, gave tensile values only up to 825 psi. when bonded with the same adhesive.

Since failure in all specimens tested occurred between

Table 1. Bond Strengths Available to the Newer Plastics

Plastic Trade-Name	Chemical Type	Surface Preparation	Adhesive Type	Bond Strength, Psi.	Comments
Cymac 325	Methyl styrene polymer.*	Methanol wipe.	Urethane prepolymer.	1,137**	Cymac delaminated.
Delrin	Polyformaldehyde.	10 Secs. at 73.5° F. in chromic acid.	Polysulfide-epoxy.	2,260**	Adhesive failure to Delrin.
Durez 16694	Orlon-filled diallyl phthalate polymer.	Sanded and acetone-wiped.	Polysulfide-epoxy.	650***	Diallyl phthalate broke. Low values due to weakness of plastic.
Lexan	Polycarbonate.	Methanol wipe.	Styrene-polyester.	1,880***	Adhesive failure to steel and Lexan.
Marlex 50	High-density polyethylene.	1 Min. at 160° F. in chromic acid.	Polysulfide-epoxy.	1,678**	Adhesive failure to polyethylene.
Moplen	Isotactic polypropylene.	1 Min. at 160° F. in chromic acid.	Polysulfide-epoxy.	1,456**	Adhesive failure to Moplen.
Multrathane	Thermoplastic urethane polymer.	Acetone wipe.	Urethane prepolymer	716***	Multrathane broke.
Grex Polyolefin	High-density polyethylene.	3 Hrs. at 73.5° F. or 1 min. at 160° F. in chromic acid.	Polysulfide-epoxy.	640***	Polyethylene broke.
Penton	Chloronated pentaerithrytol polymer.	5 Mins. at 160° F. in chromic acid.	Polysulfide-epoxy.	1,272**	Adhesive failure to Penton.

* Believed to be terpolymer of alpha-methylstyrene, acrylonitrile, and silicone.
** Tensile strength.
*** Shear strength.

the adhesive and the Delrin surface, it appears that the acid etch does not mechanically weaken the Delrin to a noticeable degree. The strength of the acid solution and time of treatment undoubtedly can be varied to provide an optimum acid concentration and pretreatment time to obtain the best over-all bond strength without damaging the Delrin.

Diallyl Phthalate

Presanded diallyl phthalate specimens showed excellent adhesion with both polysulfide-epoxy and diallyl phthalate-modified polyester adhesives at all test temperatures. Adherend failure occurred in every specimen when tested at —65, +73.5, and +160° F. An advantage of the polysulfide-epoxy adhesive, however, is that it can be cured at room temperature. On the other hand, the diallyl phthalate-modified polyester adhesive, requires an elevated temperature cure. It is quite possible, however, that the latter adhesive may display superior adhesion properties when subjected to higher temperatures; i.e., above 200° F. Chromic-acid pretreatment of the sanded specimens prior to bonding with the polysulfide-eposy adhesive proved to be superfluous.

Bond strengths obtained with the furane and styrene-polyester adhesives were almost as good as those obtained with the two adhesives mentioned above. Cohesive failure in the furane resin in some of the room-temperature test specimens indicated incomplete cure or insufficient cross-linking of the adhesive at test time. Possibly with a longer curing schedule, the furane would provide bonds equal to those obtained with the polysulfide-epoxy adhesive.

Adhesive failure occurred in several of the room-temperature specimens using the polyester resin adhesive. As in the case of the furane adhesive, however, adherend failure occurred in all low and elevated test temperature specimens. It is likely that the adhesive failure of the polyester could be circumvented by improving the composition of the resin adhesive that was a mixture of flexible and rigid polyester resins. Improvements of the bonding technique also might give consistently-high bond strengths. The failing load of the ⅛-square inch cross-sectional area of the Orlon-filled diallyl phthalate varied from 200-350 pounds.

Poor bond strengths were obtained to the smooth, unsanded, Orlon-filled diallyl phthalate surface with all adhesives. Several of the same adhesives gave good or excellent adhesion with presanded specimens, indicating the probability of a trace of mold-release agent or other anti-adhesion material on the plastic surfaces. Tests were conducted whereby the diallyl phthalate surface was wiped carefully with an acetone-dampened cloth then bonded with either the epoxy or furane adhesive. This process using no sanding gave poor results.

Lexan

Lexan was bonded very effectively by the styrene-polyester adhesive to give a shear strength of 1,880 psi. Since failure was primarily adhesive-to-steel, it safely can be assumed that this is an excellent adhesive for Lexan. The urethane prepolymer adhesive also provided good bond strenth, as did the polysulfide-epoxy adhesive. Shear strengths of 1,594 and 1,293 psi., respectively, were obtained. Alkylcyanoacrylate adhesive allowed 1,131 psi. shear strength to failure in Lexan.

Acid anhydride, elevated-temperature cured epoxy gave only 920 psi. shear strength. However, failing load was relatively low due to the presence of many small bubbles in the adhesive that formed during the high-temperature curing cycle. These were responsible for an over-all large unbonded area. Chromic-acid pretreatment of the Lexan for one second at 160° F., followed by water-washing and air drying, then bonding with polysulfide-epoxy adhesive gave resultant bonds having a shear strength of 1,440 psi. The pretreatment process may be considered essentially superfluous, since higher bond strengths are available with untreated Lexan when bonding with styrene-polyester or urethane prepolymer adhesive.

A very satisfactory solvent-type adhesive was formulated for bonding Lexan to itself for an Army Ordnance test application. It consisted of 40 parts, by weight, Lexan polymer dissolved in a mixture of 147 parts, by weight, of methylene chloride and 80 parts, by weight, of ethylene dichloride. Failure in all of these bonded specimens occurred in the Lexan.

Marlex 50 & Grex Polyolefin

Marlex 50 high-density polyethylene, when acid-pretreated for a short time at both room temperature and 160° F., gave bonds having an ultimate shear strength slightly below that obtained with low-density or branched polyethylenes given equal pretreatment times. As shown in Figure 1, however, longer pretreatment times for the Marlex 50 gave relatively sharp rises in bond strengths obtained for both treating temperatures. A maximum average shear strength of approximately 750 psi. was obtained when pretreating Marlex 50 for 24 hours at room temperature or for two minutes at 160° F. Identical pretreatment times for low-density polyethylene gave a maximum shear strength of less than 440 psi. when treated for 10 minutes at 160° F., and 390 psi. when treated for 24 hours at room temperature.

Shear strength adhesion obtained to acid-pretreated Grex Polyolefin was fairly similar to that obtained with pretreated Marlex 50. Results were not plotted, however, since polyethylene cohesive failure occurred in many of the Grex Polyolefin specimens during test. This was due to the small cross-sectional area of the polyethylene strips used in this test.

Variations in acid-pretreatment time and temperature for Marlex 50 showed that high-strength tensile bonds could be realized. After pretreating for one minute at 160° F., a maximum tensile adhesion strength of 1,678 psi. was obtained. Longer pretreatment time did not increase the bond strength.

Moplen

Moplen pretreated with chromic acid for one minute at 160° F. gave the highest bond strength in tension of the various time-temperature pretreatment variations for this plastic. A tensile adhesion value of 1,234 psi. was realized after curing the adhesive-bonded specimens for eight days at room temperature. Similarly-prepared specimens that were stored for seven days at 160° F. prior to testing at room temperature gave a tensile

strength of 1,456 psi. Untreated Moplen showed no sign of adhesion.

Multrathane

Multrathane bonded with either the urethane prepolymer or with resorcinol-formaldehyde adhesives gave strong shear strengths, with failure occurring in the Multrathane in each case. Failure with the urethane prepolymer adhesive occurred at 716 psi., while failure with the resorcinol-formaldehyde adhesive occurred at only 408 psi.

The resorcinol-formaldehyde adhesive appears to "bite" into the surface of the polyurethane, very much as it does into nylon. In addition to a possible weakening of the plastic at the bonded joint, this rigid adhesive does not allow the absorption and rather even distribution of stresses that does the elastomeric urethane prepolymer adhesive.

The polysulfide-epoxy gave a shear strength of 132 psi., while the styrene-polyester adhesive allowed only 90 psi. Failure with both of these adhesives occurred in the adhesive-adherend interface.

Penton

Penton was bonded with the urethane prepolymer to yield a tensile strength of 865 psi. The styrene-polyester, polysulfide-epoxy, and alkylcyanoacrylate adhesives gave bond strengths of 661, 586, and 500 psi., respectively. No bond could be effected with resorcinol-formaldehyde adhesive. Pretreatment of the Penton with concentrated chromic acid solution at 160° F., followed by washing and drying, then bonding with the polysulfide-epoxy adhesive increased the bond strengths. Treatment for one, five, and 10 minutes gave bond strengths of 1,136, 1,272, and 1,240 psi., respectively.

Conclusions

The data presented herein is intended to give the engineer an idea of the chemical types of adhesives and surface treatments that can be utilized in attaining bond strengths in the ranges described above for the various newer types of plastics.

Prior to design of components utilizing these plastics where bonding is required, it is recommended that the engineer use information given herein as criteria in conducting further tests that will approach more closely the types of stresses, environmental conditions, etc., that will be encountered by his particular adhesive-bonded assembly. Undoubtedly, superior bond strengths can be realized by a continued investigation of adhesives, different curing systems, and variations in surface treatment.

In many instances, an adhesive that bonds is satisfactorily to a plastic, but displays poor adhesion to another adherend surface (for instance, to a metal), can be utilized effectively by proper precoating of the metal surface. Resorcinol-formaldehyde that bonds very poorly to steel will provide excellent bonds to steel or aluminum that has been precoated with an epoxy or a nitrile rubber-phenolic adhesive.

Acknowledgment:

The Army Ordnance Corps wishes to express its sincere appreciation to the manufacturers of the plastics evaluated above for their cooperation and quick responses in furnishing samples that made this test series possible.

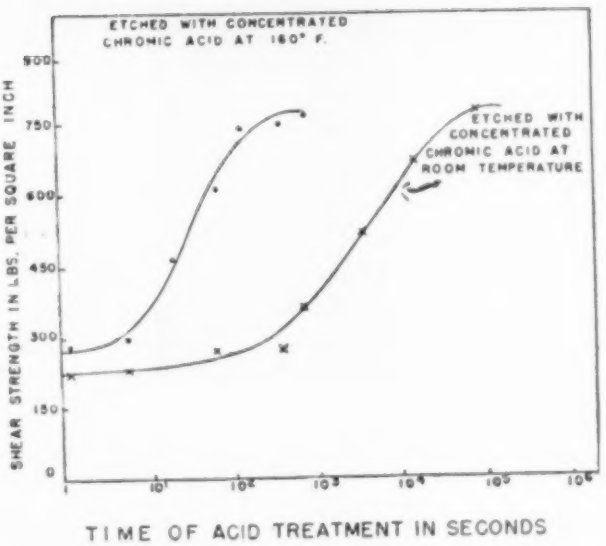

Fig. 1. Effect of acid-pretreatment time on shear strengths of Marlex 50 polyethylene bonded to steel with polysulfide-epoxy adhesive.

Bibliography

(1). Cymac 325, product of American Cyanamid Co., New York, N. Y.
Delrin, product of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
Grex Polyolefin, product of Polymer Chemicals Div., W. R. Grace & Co., Clifton, N. J.
Lexan, product of General Electric Co., Pittsfield, Mass.
Marlex 50, product of Phillips Manufacturing Co., Bartlesville, Okla.
Moplen, product of Montecatini Soc. Gen., Milano, Italy
Multrathane, product of Mobay Chemical Co., Pittsburgh, Pa.
Penton, product of Hercules Powder Co., Wilmington, Del.
(2). W. H. Schrader and M. J. Bodnar, "Adhesive Bonding of Polyethylene," PLASTICS TECHNOLOGY, 3, 12, 988 (Dec. 1957).

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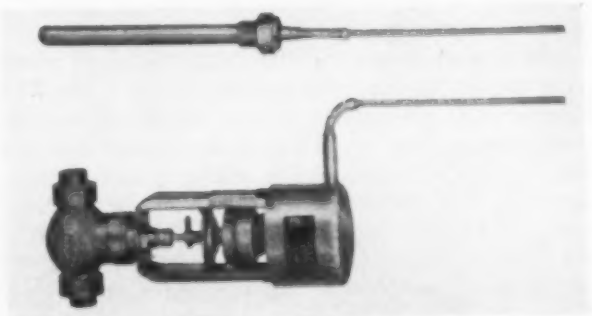

The new line of self-operated temperature regulators produced by the Fulton Sylphon division of Robertshaw-Fulton Controls Co. has a Teflon "chevron" stem packing, thus eliminating the need for lubrication and stem-packing maintenance during the life of the regulator.

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Flexible Epoxy Resins

Results are given of an investigation comparing various curing systems for flexibilizing epoxy resin castings

SINCE their introduction, the combination of physical, chemical and electrical properties of the epoxy resins has resulted in an ever-broadening field of application. As the applications in the electrical field developed, especially those potting, impregnating and casting uses where the resin must maintain a bond with dissimilar materials over a wide temperature range, the need for a method of flexibilizing the cured resin became quite apparent.

The basic liquid epoxy resin essentially is the diglycidyl ether of bisphenol A (Epi-Rez 510). Variations in the characteristics of the converted epoxy resin are obtained by various methods of curing, most of which introduce an organic structure between the molecules of epoxy resin.

The primary reason for flexibilizing the epoxy plastic is to impart thermal shock resistance in highly-filled plastics while maintaining physical characteristics over a wide temperature range with as little sacrifice of electrical properties as possible. A number of curing agents have been evaluated for this application; the Versamid resins of General Mills, and the polysulfide resins of the Thiokol Corp. The flexibilized compositions covered by this paper differ from the above in chemical structure and, in most cases, in curing mechanism.

It is the purpose of this paper to present the physical and electrical characteristics of several flexibilized epoxy resin systems. Each system can develop a wide range of flexibility, depending on the ratio of the components used. In each case, several formulations of each type were selected to show the trend in properties as the degree of flexibility was increased. The electrical properties, as well as physical properties, were determined at room temperature. The volume resistivity was determined over a range of temperatures as indicative of electrical performance. The flexibilizing materials covered by this paper are, as follows:

(1). Epi-Rez 507 in conjunction with phthalic anhydride.

(2). Epi-Rez 507 in conjunction with hexahydrophthalic anhydride, 70%, and HET* (hexachloroendomethylenetetrahydrophthalicanhydride), 30%.

(3). Trimer Acids** (Emery's 3055S). (2).

(4). Epi-Cure 85.

Anhydride Cures

Epi-Rez 507 is a liquid epoxy resin that contains hydroxyl groups and has a weight, per epoxide, of approximately 390. Due to the presence of hydroxyl groups, it particularly is recommended for use with anhydride curing agents. Mixtures of Epi-Rez 507 and Epi-Rez 510 can be cured with a variety of anhydrides to produce cured resins having wide ranges of flexibility. As the Epi-Rez 507 content of the mixture is increased, the

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*Product of Hooker Electrochemical Co., Niagara Falls, N. Y.
**Product of Emery Industries, Inc., Cincinnati, O.

flexibility of the cured resin is increased accordingly. In Table 1 are listed some physical and electrical properties of castings prepared from mixtures of Epi-Rez 507 and Epi-Rez 510 cured with phthalic anhydride.

A catalytic quantity of tertiary amine DMP-10# was used to accelerate the cure. The curing time and temperature in each case was three hours at 250° F. The amount of anhydride used in these systems was based on one equivalent of anhydride per epoxide equivalent. It will be noted that as the Epi-Rez 507 concentration is increased, the flexibility increases as evidenced by the decrease in hardness, increase in impact strength, and improved thermal shock resistance.

Another effect of increased flexibility is a decrease in the over-all electrical properties shown by increases in the dissipation factor and dielectric constant and decreases in the volume and surface resistivities. Since the room temperature electrical properties are fairly representative, it then became of interest to determine the effect of elevated temperature on the volume resistivities of these cured resins at varying degrees of flexibility.

In Figure 1, the volume resistivities are plotted against temperatures in the range of 72-200° F. The data illustrate that the volume resistivity value for the most flexible resin in the series is not only lower initially than the harder or less flexible resins, but falls off more rapidly with increased temperature.

Table 2 contains the physical and electrical property data for mixtures of Epi-Rez 507 and Epi-Rez 510 cured with a 70/30 mixture of hexahydrophthalicanhydride (HHAA) and HET Anhydride*. This eutectic mixture of anhydrides is liquid at room temperature and, for this reason, is considerably easier to work with than the less-soluble anhydrides such as phthalic anhydride. The curing time and temperature for the resin systems listed in Table 2 was three hours at 250° F. The impact strength values indicate that the resins cured with the eutectic mixture of anhydrides are not as flexible as the corresponding resins cured with phthalic anhydride. This higher degree of rigidity can undoubtedly be attributed to the presence of the HET anhydride in the curing agent mixture.

The effect of increased flexibility in this system on the physical and electrical properties of the cured resin is quite similar to that observed with phthalic anhydride. Figure 2 illustrates the effect of elevated temperature on the volume resistivities of the resins listed in Table 2. It will be noted that the electrical properties obtained using the eutectic mixture of anhydrides are not too different from those obtained using phthalic anhydride as a curing agent.

Trimer Acid Cures

Another system capable of producing resins having a wide range of flexibility is obtained by curing Epi-Rez 510 with varying quantities of Emery 3055S. Emery 3055S essentially is a mixture of 75% trimer acid and 25% dimer acid. The degree of flexibility of the resins in this series can be varied by varying the Emery 3055S content of the cured resin. In order to effect a cure in this system in a reasonable length of time, the presence

*Dimethylaminomethylphenol, product of Rohm & Haas Co., Philadelphia, Pa.

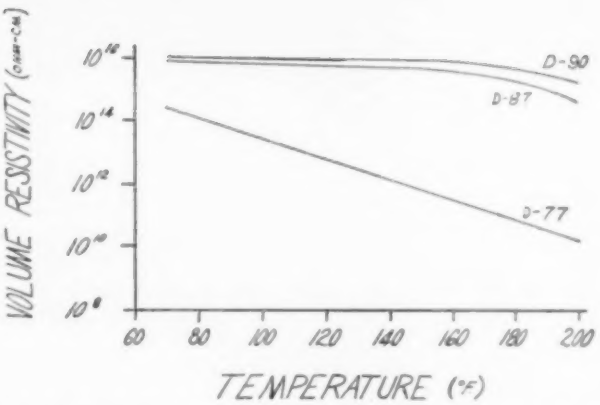


Fig. 1. Effect of temperature on volume resistivity of Epi-Rez 510/Epi-Rez 507 epoxy resin castings cured with phthalic anhydride in the range of 72-200° F.

of catalytic quantities of tertiary amines is desirable.

In Table 3 are listed the physical and electrical properties of the cured resins using varying quantities of Emery 3055S as a curing agent. In Figure 3, the effect of temperatures on the volume resistivities of the cured resins in this series is illustrated. It will be noted that at a given hardness value, the resins cured with Emery 3055S exhibit better electrical properties than the anhydride-cured systems mentioned previously.

The effect of temperature on the volume resistivity of the Emery 3055S-cured resins also is different from that observed for the anhydride-cured systems. As illustrated in Figure 3, the decrease in volume resistivity with increased temperature appears to be fairly uniform over a wide range of hardness values. In fact, even at a Shore "A" hardness of 70, which is quite rubbery, the volume resistivity values decreased uniformly with increased temperature.

Polyamine Cures

The anhydride and acid cured systems mentioned previously in this paper require elevated-temperature curing schedules, and cannot be considered for applications that require a room-temperature cure. For this reason, it was of interest to investigate a system that could be cured at room temperature and yield a series of resins possessing a wide range of flexibility.

This was accomplished by using mixtures of Epi-Cure

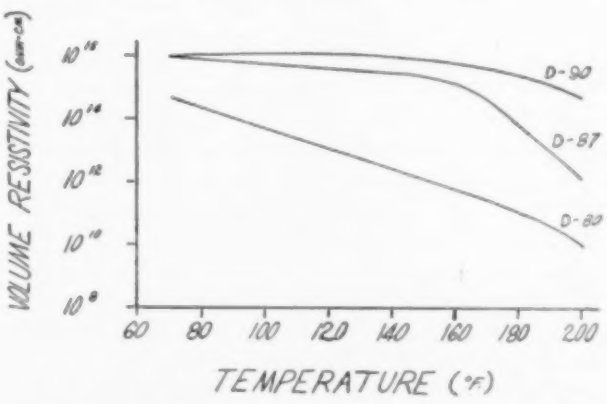


Fig. 2. Effect of temperature on volume resistivity of Epi-Rez 510/Epi-Rez 507 epoxy resin castings cured with 70:30 mixture of HHPA/HET.

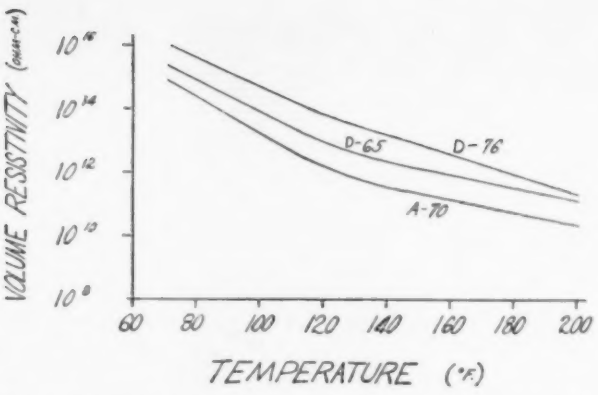


Fig. 3. Effect of temperature on volume resistivity of Epi-Rez 510 epoxy castings cured with Trimer Acids.

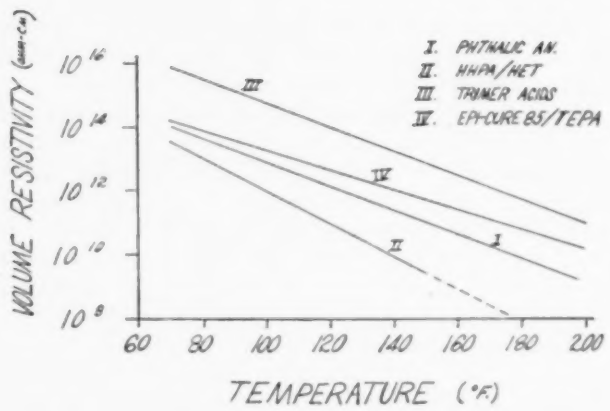


Fig. 5. Temperature-volume resistivity comparison for epoxy resin castings cured by various systems at a Shore "D" hardness of 75.

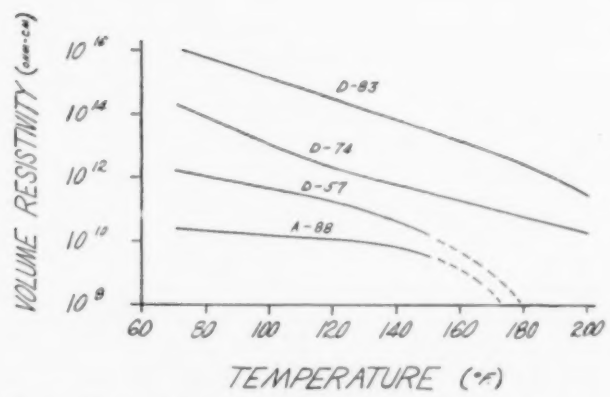


Fig. 4. Effect of temperature on volume resistivity at various hardnesses of Epi-Rez 510 epoxy resin castings cured with Epi-Cure 85 at 75° F.

85 and TEPA as curing agents for Epi-Rez 510. Epi-Cure 85 is a high molecular-weight, aliphatic polyamine having an amine-equivalent weight of 329. In a mixture with other polyamines such as TEPA, Epi-Cure 85 can be used to impart a wide range of flexibility to the cured resin. As the concentration of Epi-Cure 85 in the cured resin is increased, the flexibility of the cured resin also increases.

Listed in Table 4 are the physical and electrical properties of Epi-Rez 510 cured with mixtures of Epi-Cure 85 and TEPA. These resins were cured at room temperature for two weeks prior to testing, Figure 4 illustrates the effect of elevated temperature on the volume resistivities of the cured resins. It will be noted that the effect of increased flexibility on properties such as hardness, impact strength, water absorption, and weight-loss is quite similar to that observed with the anhydride- and acid-cured systems mentioned previously. When compared at similar hardness values, the electrical properties of the room temperature-cured resins measured at 72° F. were slightly lower, in most cases, than those obtained from the acid-cured systems, and not too different from the properties obtained with the anhydride-cured resins.

The volume resistivity values of the amine-cured resins at elevated temperatures also were quite similar to the values obtained with the anhydride-cured resins and inferior to the Emery 3055S-cured resins. Since the anhydride and acid cured resins had been cured at elevated temperatures,, it was of interest to determine the effect of post-curing the amine-cured resins, and to compare the electrical properties obtained with the values for the room temperature-cured resins.

After curing at room temperature for two weeks, the resins listed in Table 4 were post-cured for 16 hours at 250° F. The volume resistivity values then were determined at 200° F. The improvement in volume resistivity of the post-cured samples was only slight for those resins that could be measured at 200° F. However, this experiment did indicate that post-curing of room temperature-cured resins might be an important factor in improving the electrical properties of cured resin systems that exhibit borderline electrical properties.

Another important consideration in the amine-cured systems is the thermal shock resistance of the cured resins. This test involves subjecting a potted hexagon to 10 cycles between —55 and 130° C. It should be pointed out that a resin prepared by curing Epi-Rez 510 with 10 phr. of TEPA fails this test on the first cycle, whereas the addition of as little as 25 phr. of Epi-Cure 85 to this system, as listed in Table 4, introduces sufficient flexibility into the cured resin to pass the 10-cycle thermal shock test. This system also exhibited representative electrical properties at 200° F.

Discussion of Results

The results listed in Tables 1-4 permit the following generalized observations concerning the effects of various flexibilizing agents on the physical and electrical properties of cured epoxy resins:

(1). With increased flexibility (as denoted by decreased hardness), a gradual decrease in electrical properties at both room and elevated temperatures within each

Table 1. Properties of Castings Cured with Phthalic Anhydride.

Casting specimen	1	2	3
Hardness, Shore "D"	90	87	77
Composition, Phr.:			
Epi-Rez 510	100	70	30
Epi-Rez 507	—	30	70
Phthalic Anhydride	78	66	50
DMP—10, %	0.25	0.25	0.25
Curing schedule	Three hours at 250° F.		
Physical Properties:			
Impact strength, ft. lbs./in. notch	0.36	0.65	1.64
Water absorption, %	0.10	0.17	0.71
Wt. Loss, 24 hrs. @ 300° F., %	0.04	0.35	0.56
Thermal shock, 10 cycles from —55 to 130° C.	Failed	Passed	Passed
Electrical properties:			
Dissipation factor at 72° F., 1 meg./sec.	0.015	0.024	0.036
Dielectric constant at 72° F., 1 meg./sec.	4.16	4.26	4.81
Loss factor	0.063	0.102	0.175
Surface resistivity, 1 min. @ 500V	1.77×10^{15}	2.07×10^{15}	7.33×10^{14}
Volume resistivity, 1 min. @ 500V:			
At 72° F.	9.1×10^{15}	2.1×10^{16}	2.7×10^{14}
At 150° F.	9.9×10^{15}	6.3×10^{15}	7.7×10^{11}
At 200° F.	2.5×10^{15}	5.4×10^{14}	2.0×10^{10}

Table 2. Properties of Castings Cured with HHAA and HET Anhydride.

Casting specimen	4	5	6
Hardness, Shore "D"	90	87	80
Composition, Phr.:			
Epi-Rez 510	100	70	30
Epi-Rez 507	—	30	70
HHPA/HET (70/30)	116	98	75
DMP—10, %	0.25	0.25	0.25
Curing schedule	Three hours at 250° F.		
Physical Properties:			
Impact strength, ft. lbs./in. notch	0.32	0.39	0.51
Water absorption, %	0.10	0.13	0.58
Wt. Loss, 24 hrs. @ 300° F., %	0.20	1.04	2.24
Thermal shock, 10 cycles from —55 to 130° C.	Failed	Passed	Passed
Electrical properties:			
Dissipation factor at 72° F., 1 meg./sec.	0.015	0.016	0.027
Dielectric constant at 72° F., 1 meg./sec.	3.83	3.95	4.31
Loss factor at 72 F., 1 meg./sec.	0.057	0.064	0.115
Surface resistivity, 1 min. @ 500V	2.48×10^{15}	2.07×10^{15}	5.42×10^{14}
Volume resistivity, 1 min. @ 500V:			
At 72° F.	Infinite	Infinite	6.9×10^{14}
At 150° F.	1.5×10^{16}	4.4×10^{15}	1.2×10^{12}
At 200° F.	3.6×10^{15}	2.6×10^{13}	1.1×10^{10}

system was noted.

(2). At Shore "D" hardness values above 85, little difference was noted in either electrical or physical properties. This is to be expected because of the low degree of modification.

(3). In order to compare the various systems directly, Table 5 was derived from the other tables to show how volume resistivity varied with temperature at a Shore "D" hardness of 75. Figure 5 shows that at this hardness, the system cured with trimer acids definitely was superior in volume resistivity over the entire temperature range. It is worthy of note that the room temperature-cured system using Epi-Cure 85 showed up second best at this hardness, despite the fact that the other three systems were heat-cured.

(4). Highly flexibilized systems fell off rapidly in volume resistivity as temperature increased. Trimer Acid-cured systems were better by far in volume resistivity at elevated temperatures in this range than was any other system.

Considerable difficulty was encountered in handling

Table 3. Properties of Castings Cured with Tertiary Amines.

Casting specimen	7	8	9
Hardness, Shore	D76	D65	A70
Composition, Phr.:			
Epi-Rez 510	100	100	100
Trimer Acids (Emery 3055S)	80	110	140
DMP—10, %	0.50	0.35	0.25
Curing conditions:			
Time, hours	16	16	3
Temperature, ° F.	250	250	250
Physical Properties:			
Impact strength, ft. lbs./in. notch	1.80	2.80	Over 32.0
Water absorption, %	0.14	0.19	0.31
Wt. Loss, 24 hrs. @ 300° F., %	0.24	0.29	1.56
Thermal shock, 10 cycles from —55 to 130° C.	Passed	Passed	Passed
Electrical properties:			
Dissipation factor at 72° F., 1 meg./sec.	0.016	0.02	0.039
Dielectric constant at 72° F., 1 meg./sec.	3.69	3.80	4.20
Loss factor at 72 F., 1 meg./sec.	0.058	0.076	0.164
Surface resistivity, 1 min. @ 500V	5.3×10^{15}	1.1×10^{16}	4.9×10^{15}
Volume resistivity, 1 min. @ 500V:			
At 72° F.	1.4×10^{16}	3.1×10^{15}	8.4×10^{14}
At 150° F.	8.9×10^{12}	1.2×10^{12}	3.5×10^{11}
At 200° F.	3.2×10^{11}	1.4×10^{11}	3.8×10^{10}

Table 4. Properties of Castings Cured with Polyamine Combination.

Casting specimen	—	10	11	12	13
Hardness, Shore	D88	D83	D74	D57	A88
Composition, Phr.:					
Epi-Rez 510	100	100	100	100	100
Epi-Cure 85	None	25	50	75	100
TEPA	10	10	10	8	5
Curing schedule	Two weeks at 75° F.				
Physical Properties:					
Impact strength, Izod ft. lbs./in. notch	—	0.53	0.61	0.85	16.0
Water absorption, %	0.17	0.24	0.54	1.14	2.02
Wt. loss, 24 hrs. @ 300° F., %	—	0.57	1.29	2.21	3.11
Thermal shock, 10 cycles from —55 to 130° C.	Failed	Passed	Passed	Passed	Passed
Electrical properties:					
Dissipation factor at 72° F., 1 meg./sec.	—	0.021	0.030	0.043	0.065
Dielectric constant at 72° F., 1 meg./sec.	—	4.19	4.20	4.38	4.85
Loss factor at 72° F., 1 meg./sec.	—	0.087	0.126	0.190	0.301
Surface resistivity, 1 min. @ 500V	—	Infinite	7.2×10^{13}	3.9×10^{12}	4.1×10^{11}
Volume resistivity, 1 min. @ 500V:					
At 72° F.	—	Infinite	1.9×10^{12}	1.3×10^{12}	3.5×10^{10}
At 150° F.	—	8.2×10^{13}	4.5×10^{11}	2.7×10^{10}	5.3×10^{9}
At 200° F.	—	4.5×10^{11}	1.7×10^{10}	—	—

Table 5. Comparative Volume Resistivities of Epoxies with Various Cures.

System No.	Composition	Volume of Resistivity at 72° F.	150° F.	200° F.
1	Epi-Rez 507, Epi-Rez 510, and phthalic anhydride	1×10^{14}	1×10^{11}	2.5×10^{9}
2	Epi-Rez 507, Epi-Rez 510, and HHPA/HET	5×10^{13}	5×10^{9}	—
3	Epi-Rez 510 Trimer Acids	1×10^{16}	8×10^{12}	2.5×10^{11}
4	Epi-Rez 510 and Epi-Cure 85, room-temperature cure	2×10^{14}	7×10^{11}	2×10^{10}

the Trimer Acids owning to incompatibility between the resin and the Acids at temperatures of 200° F. Of the systems evaluated, the Epi-Cure 85 system would rate as the most versatile since it can be either heat-cured or cured at room temperature as was the case for these tests. The electrical properties also were quite good in hardness ranges above Shore "D" 70.

Conclusions

In conclusion, it can be stated that based on the results presented in this paper, there are several systems available for imparting a wide range of flexibility to epoxide resins. The cured resins prepared from each of these systems possess a characteristic set of physical and electrical properties that appear to depend primarily on the chemical nature of the flexibilizing agent.

—THE END

Extrusion of Rigid Polyethylene Pipe
(Cont'd. from page 720)

(6). When the plastic tube is through the draw rolls, the end is clamped or otherwise sealed to maintain air pressure in the tube.
(7). The air pressure is then increased step-wise a pound or two at a time until the outside diameter of the tube is smooth and round.
(8). The desired wall thickness is obtained by adjusting the draw roll speed in relation to extrusion machine out-put.

After the desired production rate of specification product is obtained, the air pressure, extrusion machine speed, extrusion temperatures, and draw-roll speed should be noted to simplify future start-ups.

The start-up may be made faster with less scrap by using a length of previously extruded tubing as a lead-out. The idea is to make a weld between the existing plastic tubing and the extrudate. The following steps are used:

(1). Fasten the sizing tube to the die.
(2). Push the existing plastic tube into the sizing tube and snuggly up against the die for about 30-60 seconds to soften the end. The existing plastic tube should be long enough to go through draw rolls and be sealed on the end.
(3). Start the extrusion machine and extrude into the existing plastic tube for some short period of time that can be determined only by experience; about 30 seconds usually is ample. When the right conditions are found by experience, making the weld will be a simple procedure.
(4). Turn on the water on the sizing tube.
(5). Start the draw rolls at the pre-determined speed in relation to the extrusion machine to give the desired wall thickness.
(6). Adjust the air pressure slowly to previous setting to give a smooth round wall.

This technique of starting is rapid, and produces the minimum of scrap. However, it will take time and effort to determine the exact starting conditions. These efforts will be rewarded by increased production because of faster start-up which, in turn, means more profit. For high production rates, the draw-off equipment and subsequent handling must function smoothly and positively, otherwise lower rates will result in more specification production.

Suggested Applications

Rigid polyethylene is a new material and its application for pressure piping should be engineered carefully, taking into consideration the short- and long-term physical properties. Marlex polyethylene pipe and tubing is not recommended for applications requiring sustained high unit-stresses, particularly at elevated temperatures.

The plastic pipe industry can benefit most by the proper use of new materials. For the good of the industry and insured steady growth, we recommend that the use of the material be approached in a conservative manner until longer-term experience indicates the stress-temperature-time values which may be used safely.

The following are some suggested uses for tubular goods:

(1). Low unit-stress service requiring outstanding toughness at very low temperatures.
(2). Irrigation.
(3). Waste disposal.
(4). Processing of foods and dairy products at low unit-stresses.
(5). Drainage.
(6). Industrial cooling towers.
(7). Chemical processing of highly corrosive materials and strong solvents.
(8). Lawn sprinkler systems subject to intermittent pressure.
(9). Instrument air lines.
(10). Small size industrial tubing.
(11). Tubing for subsequent fabrication, such as blow molding.
(12). Industrial electrical conduits in corrosive areas.
(13). Tubing for use in fabricated parts such as lamp posts, sign posts, etc.

Acknowledgment

Acknowledgment for help and assistance in obtaining information and experience in the use of the external-sizing technique is given to: Hall Manufacturing Company, Hackensack, N. J.; Triangle Conduit & Cable Company, New Brunswick, N. J.; Yardley Plastics Company, Columbus, O.; and Taytec Corp., Columbus, O.

—THE END

Guest Editorial

GERHARD KOSTRZEWA, *Consultant*
Franklin Park, Ill.

Shortcomings In The Post Thermoforming Industry

WITH increasing velocity, the post thermoforming industry is outdistancing many records today. It has reached an importance worthy of inclusion in the curricula of technological institutions. A fair amount of comment already has been voiced in various publications on this point.

Thermoplastic sheet and film postforming, which essentially is a simple if not somewhat spectacular procedure, attracted many people due to the comparatively low costs involved. Some spectators even feel amused watching it work. Without hesitation, it can be said that thermoplastics postforming has become an increasingly popular field.

Not too long ago, quite a number of machinery builders went into thermoforming machinery development with more or less success. Indeed, there now is a fairly adequate selection available for several types of basic or fundamental practices, as employed by schools, hobby shops, and small-sized industry. For more elaborate laboratory purposes and advanced end-fabricators, however, adequate machinery has not reached the market in sufficient quantities as yet.

It is conceded that hardly any other branch of industry has erupted into orbit so spontaneously and to so large an extent. This, however, has brought about a most serious situation with regard to lack of talented, trained and qualified personnel. Industry will face this problem for several years.

Presently, men from all classes of industry are employed in this field, with the result that disorganized touch-and-go methods are employed generally. Whether machinery building or post thermoforming techniques are in question, relatively little interest is given to numerical values and exact data in the development thereof. Considerable loss of prestige has developed due to quick-profit, make-shift practices of many manufacturers, not to mention the resulting reluctant tendency of these firms to improve these conditions which sadly enough are corrolaries to the current process. Perhaps it will not be necessary for short periods of time, but indications are that proper market evaluation and study of advanced applications will have to be visualized in the not-too-distant future, insofar as the end-fabricator is concerned.

The current picture in the machinery-building field is relatively darker. Vari-directional efforts are being made without precise results. A great deal of enthusiasm certainly is generated; unfortunately, however, it is in inverse proportion to capability.

Up to now, there has been a steady demand for standard-type machinery. But even these sometimes are not readily available. This may lead to the impression, in some cases, that sales efforts seem to accede to mere distribution. On the other hand, other types of machinery, let us say the too-advanced or more sophisticated models, proved difficult to sell. In this

connection, it would be equally fitting to say that an informative offensive towards public acceptance of such machines should be launched. Few technological publications on the part of the machinery builders' public relations staffs leak out or are disseminated for reasons that cannot easily be ascertained. Perhaps it is on account of some awkward secrecy or even lack of advanced thinking. Whatever the reason, it impedes the development of wide market possibilities and favors the slow-motion approach.

Interestingly enough, a most recent development in one segment of the vacuum-forming machinery industry seems to head for a collision by trying to close in on the packaging machinery industry. Whether these angles of approach will diverge or converge, and to whose advantage, will be highly intriguing to observe. My predictions are that the packaging machinery industry will close in on the vacuum forming industry insofar as the packaging aspect is in question, unless the latter industry engages in very careful market research, planning, coordination of sales and technical management, and considerably improves its technical staff. In any event, the vacuum forming industry will have to launch, with a view to the future, a powerful technological advertising campaign designed to attract wide industrial circles and make them familiar with the unique and vast potentials to be gained by the exploit of ultra-new applications.

It will be appropriate to point out, in this connection, that such programs will be extremely difficult to realize under present circumstances. Not until two or three years have passed will properly trained reinforcements be available from technological institutions. This waiting period could have been cut down somewhat if some of those industries have detached their leading engineers to institutions of technology occasionally in order to complement their efforts on the more significant recent developments. I think that this would be a very fine and rewarding contribution toward the solid growth of a promising industry.

It is understood that present leading manufacturers in thermoforming have transferred, with a few exceptions, from non-analogous lines. Their efforts will remain sterile with regard to advanced management and engineering if there are not sufficient reinforcements of qualified engineers to evaluate and coordinate programs on higher levels and cope with the increasing need for research work.

Recent demands and developments have far outgrown the capacities to handle these programs and research needs. This situation has been at a critical level since the very beginning of the plastics revolution, and ever-increasing demands for engineers trained in the technological skills of plastics processing are evident. Actual research work, insofar as components of the post thermoforming industry are concerned, is done by only one group: the laboratories interested primarily in materials evaluation tests. It must be pointed out, however, that increasing numbers of material producers and suppliers realize the importance that end-product and applications development have as sales media or, rather, stimulants.

Some isolated types of experimental work are handled by the machinery builders, mold makers, and preprinters. There are indications that one or the other of these groups approaches the research level, at least temporarily. At this stage of developments, it is regrettable that close cooperation, trading of information, and interchange of problems still can be classed only as theoretical ideals. Everyone tries to avoid what is not strictly his concern. This seems to have more disadvantages than advantages, however, for the simple reason that no coordinated end-results can be presented to the prospective customer.

I am inclined to believe that the point where the two industries should converge is the machinery builder. The machine is the most expensive item, and the most critical spot in the picture from which the end-product emerges. In my opinion, the seemingly-effortless accomplishment of a perfect end-product, or the development thereof, is the most conducive point with respect to sales. Naturally, all sales promotion activities, including testing, experimentation, and applications development, would have to be conducted with the most generous assistance of the materials suppliers, preprinters, and mold makers. In addition to this a coordinated and engineered booklet containing information on materials behavior, processing data, controls manipulation, and other practical information would have to be distributed. With steadily increasing complexity, it is only natural that more complex and technically integrated information be passed on to the fabricator or processor.

But who is going to do all this? Beyond the slightest shadow of doubt, an undetermined quantity of new engineers, trained particularly to meet these unprecedented requirements, will have to be made available. A heavy burden falls on institutions of technology, and a still heavier responsibility is that of the post thermoforming industry. Under present conditions, it is extremely difficult to follow-through courses on information that must be stolen away from the plastics industry. It is deplorable that no information and material for study is being fed constantly to our technical institutions and centers of education from all sources that are concerned.

—THE END

Its shipping dock and warehouse completely destroyed by fire, the Cleveland division of Midland-Ross Corp. did a fast and efficient rebuilding job with Steelbestos fire-resistant siding and translucent Structoglas fiberglass-reinforced acrylic glazing. The latter product is obtainable from the Structoglas division of International Molded Plastics, Inc.

PLASTICS TECHNOLOGY

EXPLORING FABRICATION TECHNIQUES

By: L. J. ZUKOR, *Engineering Editor*

New York University Research Division . . .

. . . working with the Veteran's Administration, informs us that practically all of the latest plastic materials are either being used or tried for prosthesis. Until recently, members of the plastics industry have not had the opportunity to get first hand information on the application of their materials to physical medicine. Some figures as to the extent that plastics play in the manufacture of better, lighter, and more durable artificial limbs can be seen from the following:

World War II produced 18,500 amputees, while this same period saw 80,000 civilian amputees resulting from one cause or other. The Archives of Physical Medicine stipulate that as of October 1949 there were in the United States about 500,000 amputees. It is estimated that the annual rate of amputations in this country runs to about 30,000, not including hemiplegiacs afflicted with paralysis of various portions of the body.

Over one million pounds of plastic material presently go into the manufacture of prosthetic limbs and braces each year.

One method presently employed, involves the building up of successive layers consisting of stockinet fabric impregnated with epoxy resin. This presents a time-consuming, rather complicated procedure. The end result could be called monocoque design, wherein the heavy skin buildup is the actual structural member.

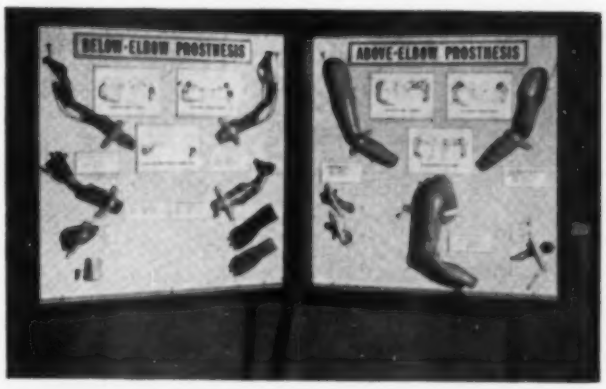
Even by present techniques, it should be possible to approximate more closely the natural limb: i.e., a blow-molded skin formation with the color, texture, and convolutions of the human limb could be formed from polyethylene. This could be fitted over structural aluminum members that would be counterparts of the skeletal bones. In nature, tendons and muscle tissue keep the bones in proper position with respect to one another to enhance further these structural qualities. To reproduce this same relationship in the artificial limb, a flexible vinyl plastic could be substituted. Using only the available materials, it should also be feasible to duplicate any of the joints found in nature. The Teflons and nylons, in this sense, make best bearing materials.

Since 1947 a federally sponsored research program,

Forming the artificial limb—"milking down" the layers of epoxy impregnated stockinet

nationwide in scope, has endeavored to bring modern science and technology to bear on the problems of prothesis.

The steadily increasing demand for lighter and more comfortable prosthetic limbs and braces has contributed to the formation of many agencies who are presently studying the requirements of the amputee and designing new devices. These agencies would like to receive the latest information from manufacturers who have processes or materials that are applicable to their needs.



A brief list of the agencies are as follows:
Veterans Administration
Prosthetics Center
252 Seventh Avenue
New York 1, New York

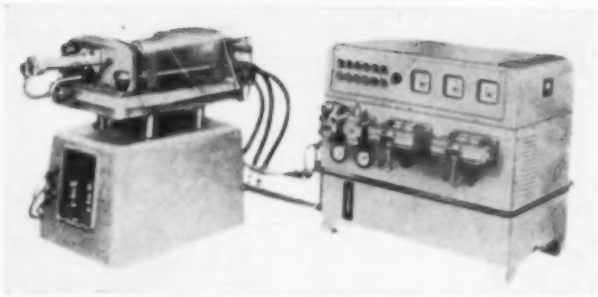
Army Prosthetics Research Laboratory
Walter Reed Army Medical Center
Forest Glen Section
Washington 12, D.C.

Other listings will be supplied by the writer upon written request.

•

An automatic blow molding machine . . .

. . . is being offered to the plastics industry by the Blow-O-Matic Corp. of Bridgeport, Conn. This machine can be attached to almost any medium sized extruder equipped with a vertical head that will extrude a tubular parison downward.



In operation, the head extrudes a tube of plasticized material. As soon as this tube has reached a predetermined length, the molding assembly moves upwards, with the mold halves open. When this vertical movement is completed, an automatic switch starts a horizontal movement of the two halves of the mold, which are clamped by hydraulic pressure around the tube. The tube end then encloses a nozzle-type mandrel mounted below it through which the blowing of the bottle begins. This happens as soon as the mold is closed. The molding assembly descends while the blowing action is taking place. Simultaneously, the tubing is cut free by a knife fitted to the extruder and operated by a doube-acting air cylinder.

The hydraulically-operated movements are controlled by adjustable timers and synchronized with the speed of the extruder screw, which produces the plastic tubing continuously. When the molding unit has reached its bottom position, the blowing action stops and the mold halves open. In the fully-open position, the tool activates a switch which causes the blowing mandrel to make a short downstroke, thus withdrawing it from the end of the tube, which is still lightly attached to the bottom of the blown container. An airjet then comes into operation, blowing the finished bottle from the machine into a receptacle. In the meantime, the constantly-working extruder has produced another length of plastic tubing and the cycle starts to repeat. . . . This machine features complete accessability of all components for easy maintenance.

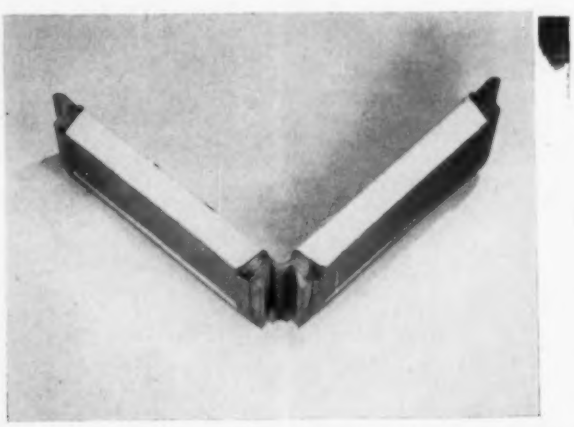
Indestructible Flip-Flop Lid

Nopcometer measures predetermined amount of urethane foam ingredients into the right half of Keaton's flip-flop lid. The left half has been filled, and the top is clamped in place until foaming subsides.

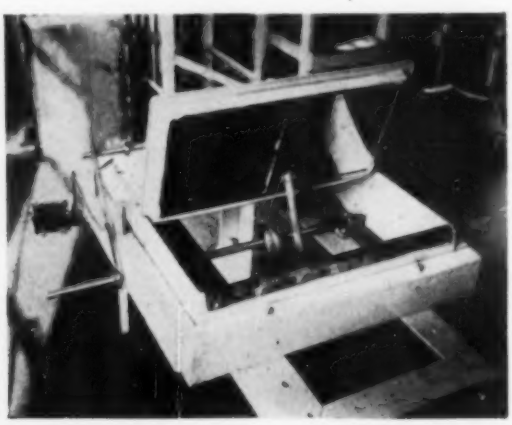
By using a urethane foam filling, Keaton Rubber Co., Kearny, N. J., has eliminated all nuts, bolts, and screws from its new "flip-flop" lids for ice cream and cold drink storage cabinets. Strength of the foam obviates the need for a separately-assembled hinge; therefore, the firm is able to mold the lid frame, hinge, and knobs as a single piece of neoprene. Tested continuously for 240 hours on a flexing and slamming device, the lid was opened and slammed shut 205,000 times—equal to about 20 years of service—with no sign of wear.

A Lockfoam formulation which would give a 6-psi. foam was chosen for the urethane insulation. As the frame is molded, two stainless steel pans are inserted to form the bottom. Mounted on special jigs, the frames are inserted under a Nopcometer and a precise amount of resin and foaming agent are metered into each side. Immediately thereafter stainless steel pans are clamped in place to form the tops. The foam completely fills all the spaces between the pans and, being highly adhesive, bonds tightly to the steel and neoprene.

Both Lockfoam and the Nopcometer are products of Nopco Chemical Co. The latter is leased to Lockfoam users, and is designed to make mixing and measuring of the foam ingredients a fully automatic operation. The finished foam constitutes a ten-times expansion of the original ingredients' volume, and has become the main structural member of the lid.



Cross section of flip-flop lid shows white Lockfoam core bonded tightly to stainless steel pans and neoprene frame.



Keaton "slamming machine" was used to test lid's durability. Lid was slammed 205,000 times with no evidence of wear.

News of the Societies

A group of SPE New York section members view a valve-gating demonstration at W. R. Grace & Co.'s polymer chemicals laboratory.

SPE New York Section Tour

A recent inspection tour of W. R. Grace & Co.'s polymer chemicals division laboratories drew 100 interested members of SPE's New York section to Clifton, N. J., where they participated in a four-hour program arranged by Arthur L. GeWertz. Dinner at Gene Boyle's Restaurant was followed by a welcoming address by T. T. Miller, divisional president.

Included in the itinerary were the division's library, R & D section, chemical and physical testing laboratories; as well as an inspection of the compounding, injection molding, and extrusion facilities. One of the highlights of the tour was a demonstration of an improved technique in the injection molding of high density polyethylene. This method precompresses a shot in the cylinder and, by valving the gates, injects the shot at such a high velocity that it does not begin to solidify and crystallize until it reaches all parts of the mold. Simultaneous cooling at every portion of the piece yields an improved product at reduced molding cycles, plus lowered scrap loss and finishing cost. Concluding the program, section members viewed a color film depicting the history and scope of W. R. Grace & Co.'s operations.

SPE New York Section

The last meeting before the summer recess for SPE's New York Section took place June 18 at the Governor Clinton Hotel. The vinyl subgroup, meeting for the second time, again drew a substantial and interested audience. Papers presented before this group are reported elsewhere in these columns.

At the general meeting, Robert A. McCarthy, Monsanto Chemical Co., spoke on "Impact Polystyrene—Workhorse of the Industry." Impact styrene's main advantages are economy, variety of permissible fabrication methods, as well as availability of many types for different applications. Its low cost permits competition with other materials in the durable goods field where toughness and rigidity are important. Advantageous rheological properties facilitate compression or injection molding, extrusion, and vacuum forming.

Maurice T. Bolmer, Bakelite Co., discussed "Polyethylene—Variety of Properties and Products." He pointed out that the two key variables in the basic polyethylene structure are: length of chain; and length and number of branches. As these variables change, the properties of the plastic vary. Since melt index and density represent a conjunction of properties, changes in these factors result in different physical characteristics and behaviour of the material. These factors may serve as an indication as to what type polyethylene can best serve the desired purpose.

Addressing the reinforced plastics meeting, Mrs. H. R. Merriman, Bloomingdale Rubber Co., spoke on "Structural Adhesives for Metals," discussing the history and development of structural bonding, and the physical properties and applications of adhesives. She pointed out that a review of the important characteristics of adhesives indicates that the prime considerations for a variety of applications would be: adhesive stress rupture and creep characteristics; weathering and aging properties; reasonable peel strength to allow fabrication and installation without damage to the assembly; and cost considerations.

Substituting for J. L. Been, Rubber and Asbestos Corp., James A. Houle delivered the scheduled lecture on "Structural Adhesives—Their Character and Manufacture." The discussion included an outline of the basic concepts of adhesive formulations, as well as the general relationships between available raw materials and physical properties of the adhesive. A structural adhesive must equal or surpass the performance requirements of the joint under the temperature and corrosive conditions to which it may be exposed. Phenolic and epoxy based resins with elastomerics are used for bonding metals and plastics.

Plastic Pipe Progress

Burgeoning acceptance of plastics pipe by states and municipalities as well as individual consumers points toward a $90-million sales level by 1960, according to Bert S. Montell, Plastic Pipe Research Council, Society of the Plastics Industry, Inc., New York, N. Y. Reporting to the Pacific Northwest Section of American Water Works Association recently, he pointed out that the number of separately owned plastics pipe systems currently in use have reached the 1½-million mark, and that 75% of all plastics pipe sold today are for use in water supply systems.

A Council-sponsored research project, undertaken by the National Sanitation Foundation, has resulted in the adoption of federal commercial standards for polyethylene, SWP-butyrate, and IPS-PVC piping. Simultaneously, these standards are being processed through ASTM and ASA for eventual adoption by those agencies.

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News of the Industry

At Hancock's central dispatch room, all phases of production are registered at the display panels. Verbal instructions are transmitted through the public address system at right.

Monitored Production System

Increased production economies are being attained at Hancock Mfg. Co., Jackson, Mich., with the incorporation of a telecontrol system that electrically monitors the operation of machines engaged in mass-production work. Made by a sister-firm, Control Systems Co., the electromechanical circuitry is said to have saved the company more than $100,000; 80% in non-productive payroll, and 20% down-time.

In the Hancock plant, where automotive components are machined, each production station carries a small control box linking the machine to a display panel located in a central control and dispatch room. Sensors on each unit automatically signal the production of each part to the display panel where electromechanical counters record the number of parts produced during the shift. A balance counter, preset to the total number of parts needed at the start of the production run, gives a running check on the number of parts remaining to complete the order, and actuates visual and audible signals in the control room at the end of the run.

Another function of the system is that of automatic time-keeping. Should production stop for any reason, the operator throws an alarm switch on his control box, and a red light flashes both at his station and in the dispatch room. A roving foreman, notified by public address system, proceeds to the machine concerned and ascertains the difficulty. He then confers with the control-management through a telephone handset which can be plugged into a receiving jack at the machine.

If the difficulty is a minor one, the operator is placed on down-time for a minimum period. Should the breakdown be major, he can be transferred to another machine while repairs are being made. This procedure also is used when the operator needs more parts, or when excess finished items must be removed.

In the central control section, the display panels carry an identification number for each machine in addition to indicators which record productive time, down-time, parts produced within the shift, and the balance register which subtracts parts produced from parts required. Cost per machine at Hancock's 200 unit production line is approximately $250, but this figure will increase somewhat with smaller installations.

Eighth Plastics Exposition

Theme for the eighth National Plastics Exposition, which will be held in Chicago on November 17-21, is "Plastics for Profits." Exactly 90 years old this year, the plastics industry will attempt to show how new materials, methods, machines, and techniques are helping manufacturers to stem rising costs in an inflationary economy. Concurrent with the Exposition, which will be held at the International Amphi-theatre, is the SPI Annual Conference. This Conference is scheduled for the Hotel Morrison, with W. D. McKay of Keolyn Plastics, Inc., as general chairman. John J. Bachner, president of Chicago Molded Products Corp., is chairman of the Exposition committee.

Harshaw and Kentucky To Merge

Negotiations are about to be completed for a merger of Harshaw Chemical Co., Cleveland, O., and Kentucky Color & Chemical Co., Louisville, Ky., with the latter firm operating as a separate subsidiary corporation. Initial attention will be devoted to improving and expanding the Louisville plant, plus an extension of its research and product development activities. No change in Kentucky's sales organization is contemplated.

Reichhold Deep-Water Terminal

Plans for building a $1-million terminal on the ship channel at Mobile, Ala., have reached the construction stage, it was announced recently. Dredging for deep-water operations and construction of dock facilities for both coastal barges and ocean-going vessels is currently underway.

Completed, the terminal will have a capacity of several million gallons of liquids, plus facilities for bulk handling of dry chemicals. Space will be allocated for drumming and storage of finished products. In addition to all forms of water transportation, shipments can be made from the terminal by either railroad or truck.

Petro-Tex Isobutylene Plant

High-purity (99%+) isobutylene should be available in pressure-type tank cars by December of this year, the scheduled completion date for Petro-Tex Chemical Corp.'s new plant at Houston, Tex. Capacity will be sufficient to supply a substantial part of this country's current needs. Currently a major supplier of butadiene and other olefins, Petro-Tex is owned jointly by Tennessee Gas Transmission Co., and Food Machinery & Chemical Corp.

Builds Maleic Anhydride Unit

Construction is presently underway on American Cyanamid's $1-million maleic anhydride manufacturing plant at Bridgeville, Pa. The firm is America's largest consumer of this organic chemical, which is used in the production of paints, varnishes, laminates, and agricultural chemicals.

An outdoor-type installation, the new unit will cover approximately two acres of land adjacent to the company's present facilities at the Bridgeville site. It will be incorporated into the operations of the plastics and resins division. Scheduled for completion late next year, the facility has an initial capacity of 14-million pounds annually. Thirty additional employes will be added to the staff.

Du Pont Opens Another Lab

Du Pont's $5-million service laboratory, shared jointly by the Electro-chemicals and Pigments departments, has been in operation now for two months. Located in Chestnut Run, near Wilmington, Del., the red brick and steel frame structure is similar architecturally to the other sales development laboratories opened there in the last five years. Although some facilities are shared jointly by the two departments, separate labs are available for product development in the paint, metals, textile, plastics, paper, ink, and allied chemical fields.

Prior to completion of the new building, the Electrochemicals department maintained sales service facilities in Niagara Falls, and the Pigments department operated at Newark, N.J., and Newport, Del. The integrated laboratory contains 81,000 square feet of floor space; includes 150 separate rooms; and employs a staff of 130 chemists, engineers, and other technical personnel.

The one-story Electrochemicals wing is divided into four major product areas: vinyl, sodium, peroxygen, and chlorine.

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Seventeen individual labs are grouped around large demonstration areas containing equipment for duplicating customers' operations on a semi-works scale. The vinyl section is devoted to polyvinyl alcohol and polyvinyl acetate, including end-use evaluation in paints, adhesives, paper coating, and other products.

The Pigments laboratory occupies two floors, and has facilities for developing tailor-made pigments for the paint, plastics, rubber, paper, ink, and allied industries. The area contains 40 laboratories and test rooms, as well as space for housing mill, grinding, accelerated weathering, spraying, and oven-baking equipment.

National Tool Buys Auto-Vac

Auto-Vac Co., manufacturer of machinery for sheet forming, has been acquired by National Tool Co., of Cleveland, O. This marks National's first step in its diversification program, plus its entry into the plastics field. Auto-Vac will continue to operate in Bridgeport, Conn., as an independent division under E. Bowman Stratton, former owner and member of PLASTICS TECHNOLOGY's Editorial Advisory Board. Mr. Stratton has been elected a vice president of the parent organization.

The move is expected to benefit Auto-Vac as well as National Tool. Added working capital will be available for increasing engineering, design, and manufacturing facilities. Robert L. Butzko, former partner of Mr. Stratton, will continue his association for the next two years as a consultant.

UL Recognizes Vinyl Claim

Kohinor 652, a dry-blending PVC resin produced by Pantasote Co.'s Eleonora chemical division, has been recognized by Underwriters Laboratories as an "interchangeable basic resin." The material has been used successfully in calendering and extrusion, its speed of dry blending making it a very adaptable product. UL recognition gives it entree into the wire and cable field. Underwriters Laboratories also recognized Kohinor W-200 compound for types T, TW, 60° C, and 80° C, insulation.

Schedules Anthraquinone Plant

American Cyanamid Co. has revealed plans for building a multi-million dollar anthraquinone plant in Bound Brook, N.J. The unit will be operated by the organic chemicals division, using a completely new manufacturing process. When completed, the plant will replace and expand existing production, and will include facilities for making methyl anthraquinone, naphthoquinone, and phthalic anhydride.

The process will involve the direct oxidation of naphthalene in a fixed-bed catalytic converter. Anthraquinone is an inter-

mediate in dye manufacture, and naphthoquinone is used in the manufacture of plastics. Phthalic anhydride finds usage in dyes, pigments, alkyd coatings, and rubber chemicals. Commercial production of these products at the projected plant is scheduled for late 1959.

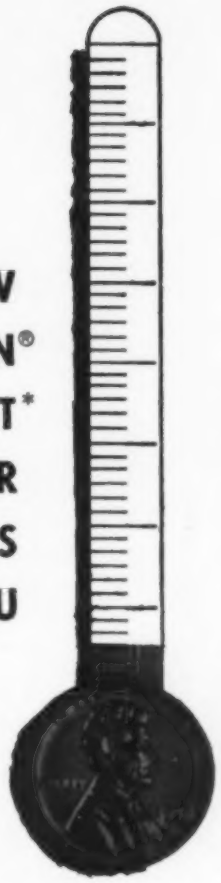
Du Pont-GM Antitrust Suit

E. I. du Pont de Nemours & Co. has filed a proposal designed to satisfy the Supreme Court's mandate for "equitable relief" in the General Motors antitrust suit. This plan counts the Department of Justice's proposal which would require the firm to distribute its General Motors common stock (63-million shares) to its stockholders over a ten-year period, with the exception of Christiana Securities and Delaware Realty & Investment Co. Shares allocable to these investment companies would be sold by a trustee, and they would receive the cash proceeds.

On a pro-rata basis, Du Pont shareholders would receive 1⅜ shares of GM stock for every share of their Du Pont stock. This would seem a windfall, in spite of the fact that their market value would be taxed as ordinary income to the stockholders. A closer examination shows this not to be the case, however, since part of the value of Du Pont stock is predicated on the firm's GM holdings. Also, as part owners of Du Pont, the stockholders already own a portion of the GM stock and would be taxed for receiving what is already theirs.

Implications of the stock transfer go much further than taxes, however, since the respective values of both firms' stocks could well be expected to depress. The trustee would be required to sell 2,117,272 shares of GM stock annually and distribute another 4,236,278 shares for a period of 10 years. Taking the current market value of $35 per share, this would mean that a minimum of $74-million worth of GM stock would be offered on the market annually for the next decade. Since this practically doubles the annual offerings of GM stock, whether the stock would sell at $35 is certainly a moot question. This imposes a financial hardship on other GM shareholders, the very people whose interests were in question.

Many Du Pont stockholders would be forced to sell either Du Pont or GM stock in order to pay taxes on their new acquisitions. Should their income or holdings be sufficiently large, they could be taxed up to 91% of the stock's value. To avoid this payment, many Du Pont stockholders may sell their Du Pont holdings and pay the 25% capital gains tax. This conceivably could glut the market with Du Pont stock, lowering its sale price. For a ten-year period, GM and Du Pont could be prevented from raising expansion capital through the sale of common stock in an already saturated market. The decline in market values of the two stocks easily could instigate heavy selling of other stocks, particularly in the chemical and motors industries.



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Plastolein 9078		DDA	Plastolein 9078		DDA
Parts Geon 101	100	100			Borderline
Parts Plasticizer	48	49	Masland Impact, °C	—40	at —40
Tensile, psi	2650	2400	Extraction, mg/in²		
Elongation, %	365	360	Water, 24 hrs. @ 50° C	0.2	0.1
Modulus, 100%, psi	1130	1240	Soapy Water, 24 hrs. @ 50° C	1.0	0.4
Hardness, D.10 sec.	85	89	Min. Oil, 24 hrs. @ 25° C	11.1	19.8
Volatility, SPI, 70° C			Compatability, Roll		
1 day-mg/in²	1.9	2.3	Spew	Slight	Severe
7 days-mg/in²	8.0	9.1			

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The Du Pont counter proposal would carry out the mandate of the Supreme Court by depriving that firm of all rights and attributes of a stockholder which could influence General Motors to deal with Du Pont. GM stock would be voted, not by the company, but pro rata by the 185,000 Du Pont shareholders. Christiana and Delaware Realty would pass on their voting rights to their 4,000 shareholders. Du Pont could not acquire additional GM stock, and there would be no common directors, officers, or employes without Court approval. Even if so approved, he would be forbidden to take part in any relationships between the two firms.

Polyethylene Shipping Bags

Concurrent with the acceptance by the Railroad Joint Classification Committee of 10-mil polyethylene bags for domestic rail shipments of plastics materials, came the announcement of their commercial availability from Chippewa Plastics, Inc., Chippewa Falls, Wisc. Specifications established by the Committee call heat-sealed bags of virgin, extrusion grade polyethylene having a tensile strength of at least 1,800 psi. at the seal, or a stretch of less than 350%. Net weight of the bag's contents is not to exceed 50 pounds.

Rolling down the conveyor belt are 50-pound lots of Monsanto polyethylene in 10-mil polyethylene bags.

Though the approval is limited to plastics materials, it is expected that this announcement will pave the way for new markets with enormous potential. Monsanto has been using the bags under test shipping permits for several months, and has experienced no breakage with 50- and 100-pound lots. Manufactured from Monsanto polyethylene 706, the bags consistently proved superior to other type bags in repeated drop tests from various heights. Cost of the polyethylene bags, in large lots, should range from 20-30c per bag depending upon size and printing requirements. These prices compete with most standard shipping sacks and containers.

Guide To Industrial Buying

The value of plastic and elastomeric materials sold or otherwise used in 1957 was estimated at $1.822-billion, according to the Sales Management Survey of Industrial Buying Power* for that year. This represents a 48% increase over U. S. Census figures for the year 1954, plus a 12% increase in employment in the plastics industry.

Under the designation "plastics products not elsewhere classified" in the Standard Industrial Classification, the value of products shipped is estimated at $1.682-billion, for a gain of 14.1%. Total employment went up 5.4%. These are typical figures set forth in the second annual survey, based on the 4-digit Standard Industrial Classification covering 450 industries on both national and county levels. It is purported to be the most precise pinpointing of industrial buying power available to industrial market research.

For both of these classifications (plastics and elastomers), estimates are given as to the number of plants and employes for the 20 leading counties in the United States. This represents 27.2% of the plants and 75.9% of the total employment. Counties, states, plants, and number of employes are listed as follows: Middlesex, N. J., five plants, 4,100 employes; Hampden, Mass., three plants, 3,000 employes; Spotsylvania, Va., one plant, 2,900 employes; Erie, N. Y., four plants, 2,700 employes; Bucks, Pa., one plant, 2,500 employes; Chesterfield, Va., one plant, 2,400 employes; Midland, Mich., one plant, 2,200 employes; Clinton, Ia., one plant, 1,600 employes; Davidson, Tenn., one plant, 1,600 employes; Niagara, N. Y., five plants, 1,600 employes; Galveston, Tex., one plant, 1,400 employes; Alleghany, Pa., four plants, 1,300 employes; Essex, N. J., four plants, 900 employes; Union, N. J., eight plants, 800 employes; Jefferson, Ky., two plants, 800 employes; Transylvania, N. C., one plant, 800 employes; Hudson, N. J., three plants, 800 employes; and New Castle, Del., seven plants, 700 employes.

The twenty leading counties are surveyed also for plastics products not elsewhere classified," listing, by area, 47.2% of the plants in the country which account for 97% of the total employment in this division of the industry. U. S. Census requirements under the non-disclosure rule heretofore have prohibited much of this information. The Sales Management survey thus fills this gap in suppliers' market research. Industrial sales potentials can thus be related to areas, enabling firms to set up territorial sales quotas, promotion budgets, and selling organizations.

* Sales Management 1957 Survey of Industrial Buying Power. Published by Sales Management, a Bill Brothers Publication, 386 Fourth Ave., New York 16, N. Y.

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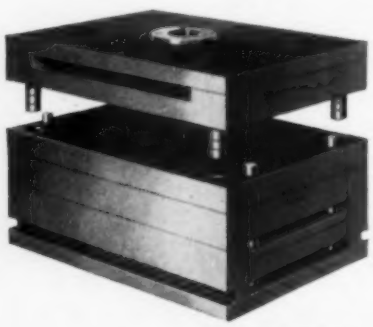

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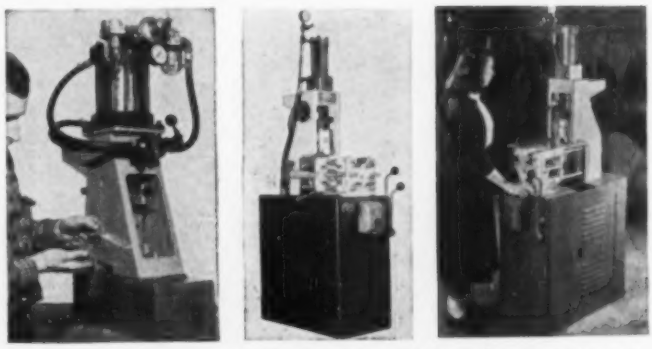

(left) Mod. 45 "Wasp" (bench), inserts, encapsulating. (center) "Universal", best features of 4 MINI-JECTORS. (right) Mod. 60 "Super Hornet", fast, conventional molding. Many others.

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Names in the News

Herman Sokol

Herman Sokol has been elected executive vice president of Heyden Newport Chemical Corp. He previously served as vice president in charge of research and development for Heyden and, since the merger with Newport, Dr. Sokol has been responsible for coordination and integration of research facilities.

W. Samuel Carpenter III, director of sales for Du Pont's petroleum chemicals division, has been named assistant general manager of the firm's electrochemicals department. He succeeds **Charles B. McCoy,** who has been named general manager of the elastomer chemicals department. Mr. Carpenter first joined the firm as an industrial engineer over 20 years ago, and has served in many executive capacities since that time.

L. William Ullrich has been named to head-up the new product-research and development department at Electromold Corp., Trenton, N. J. He joined the firm as a chemist in 1954.

Frank L. Bracy has been appointed a technical service engineer at Plax Corp. He joined the firm as a chemical engineer, and had been serving as a development engineer in the research and development department.

Raymond W. Hargrove has been named sales manager for textile resins in the Central Atlantic division of Reichhold Chemicals, Inc. He will maintain headquarters in Charlotte, N. C.

Sidney Lauren has been named manager of technical service for surface coating emulsions at Reichhold Chemicals' Elizabeth, N. J. plant. A professor of engineering at Brooklyn Polytechnic Institute, he served as senior research chemist in the adhesives and finishes section of the Johns-Manville Research Center.

Charles E. Trescott has been elected vice president and general manager of Zenith Plastics Co., a Minnesota Mining & Mfg. subsidiary located in Gardena, Calif. He joined the firm last year as manufacturing manager. A retired U. S. Navy captain, Mr. Trescott headed the Naval Academy's department of marine engineering and also served as commander of the San Francisco naval shipyard.

Frank W. Reinhart, chief of the plastics section at the National Bureau of Standards, was awarded an honorary doctor of science degree by Juniata College, Huntingdon, Pa. Dr. Reinhart is a graduate of the college and served on the faculty for seven years.

Nolan B. Sommer has been appointed assistant to **K. H. Klipstein,** executive vice president of American Cyanamid Co. He joined the firm in 1944 as a research chemist, subsequently becoming manager of market development for Jefferson Chemical, a Cyanamid subsidiary. Dr. Sommer also served as manager of the parent firm's product development department, and has been marketing manager for the plastics & resins division since 1955.

Harry M. Dent, Jr.

Harry M. Dent, Jr., has been appointed a district sales manager for the Durez Plastics division of Hooker Chemical Corp., with headquarters centered at the division's home office in North Tonawanda, N. Y. He first joined Durez in 1944, has sold, and has worked with the product application group.

Orville W. Taylor has been assigned to the Henry, Ill., general chemicals plant of B. F. Goodrich Chemical Co., as senior engineer. He joined the firm in 1950 as a general foreman of utilities.

William A. Hart has been appointed technical and sales representative for National Tool & Mfg. Co. Kenilworth, N. J., manufacturer of standard mold sets and accessories. A veteran of the plastics and die casting industries, Mr. Hart will cover the Chicago area from headquarters in St. Charles, Ill.

Paul H. Smith, Dallas district manager for Du Pont photo products, has been named manager of sales development for photopolymer printing plates. He is succeeded by **Fenner G. Headley.**

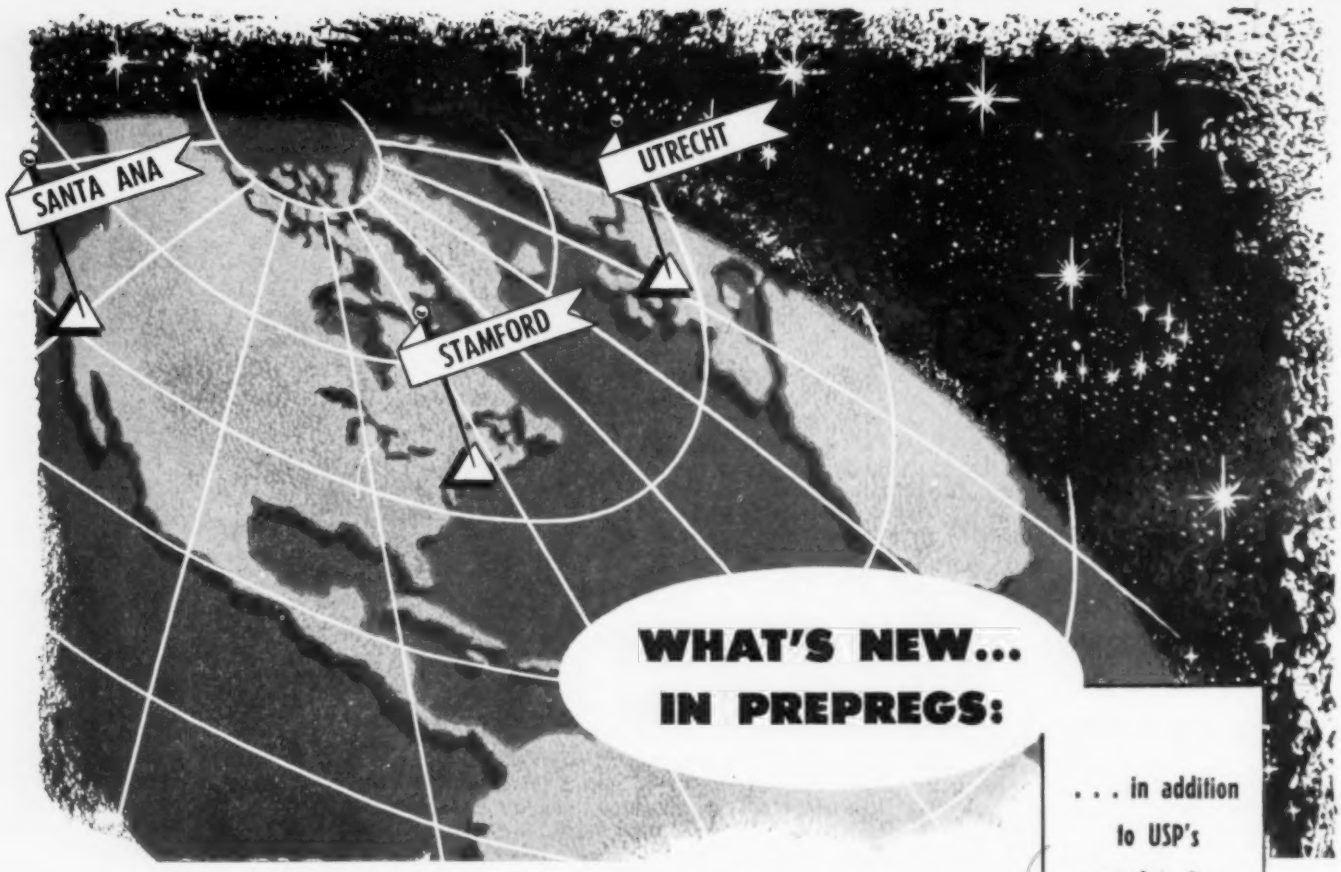
John M. Quinn has been named to represent Synthane Corp., in Vermont, western Massachusetts, northeast Connecticut and northeast New York. He will make his headquarters in Springfield, Mass.

S. Antoine Khawam and **Guy Knafo** have joined the research and development laboratories of Nopco Chemical Co.'s plastics division. Dr. Khawam was formerly associated with National Aniline and Dr. Knafo with the French Institute.

Robert L. Hatch and **Robert G. Worman** were named to supervisory positions, and **Sterling F. Strause** was named quality control specialist with General Electric Co.'s chemical and metallurgical division. All three men will be concerned with Lexan polycarbonate resin.

George E. Ham has been appointed to the position of technical director for Spencer Chemical Co.'s plastics division. Dr. Ham formerly served as research director for J. T. Baker Chemical Co., and has held positions with Monsanto and Shell Development Co.

William E. Browning has been named sales manager for Panta-Pak a division of Pantasote Co. He is the former sales manager of United Can Co., and Doeskin Products.



. . . in addition to USP's complete line of POLY-PREG . . .

TACKY LOW-PRESSURE SILICONE

Until very recently, all silicone prepregs were dry and stiff, making it extremely difficult to lay-up and mold complex shapes, particularly at low pressure.
Formerly, silicone prepregs could be provided with some degree of drape and tack, artificially induced by leaving a relatively high percentage of impregnating solvent in the fabric. However, this led to short shelf life and molding problems.
Now available to industry is a silicone-impregnated fabric with tack, drape and low residual volatile content — Tacky Low-pressure Silicone S-890 — pioneered by U. S. Polymeric. This splendid new silicone Poly-Preg offers these advantages.

. . . excellent drape and tack for laying-up complex shapes
. . . ability to mold easily at vacuum-bag pressure
. . . low residual volatile content, minimizing curing troubles
. . . good shelf life

Tacky Low-pressure Silicone S-890 normally is applied to heat-cleaned glass cloth with a neutral pH finish, but it also can be applied to asbestos and other high-temperature reinforcements. It has many applications in the aircraft and missile field, specifically for items such as hi-temperature radomes, hot-air ducts and drag-chute containers. In fact, Tacky Low-pressure Silicone S-890 may be used in a variety of aircraft or missile applications where a combination of high temperature and electrical properties are necessary.

Expanded production facilities have greatly increased the flow of U. S. Polymeric POLY-PREG from plants on either coast, to give you the kind of service and delivery you demand.
U. S. Polymeric's extensive line of preimpregnated paper, glass cloth and mat now include:

- . . . **Hi-Heat Phenolic POLY-PREG (with 91-LD**
- . . **Ultra-High-Temperature Resin POLY-PREG (with 37-9X)**
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- . . . **Silicone POLY-PREG**
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- . . . **Phenolic POLY-PREG**
- . . . **POLY-PREG Two-In-One (with Silicone Modified Rubber)**

Through continual research and development, Polymeric's staff of engineers are creating new products and processes, such as POLY-PREG T.I.O., to meet the ever-increasing demands of industry and defense.

For specific recommendations concerning materials and material specifications, engineering assistance on any individual application is available upon request. Merely write: Engineering Department, U. S. Polymeric Chemicals, Inc., Stamford, Conn.

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News from Abroad

New Styrene Copolymers

Polectric SM 11 and Lucentine 82 are the trade names of two new styrene copolymers with interesting electrical properties at elevated temperatures that have been developed at the Yarsley Research Laboratories, and are being produced by the affiliated Lucent Products, Ltd., both of Chessington, Surrey, England.

Polectric SM 11 is a copolymer of styrene and alpha-methylstyrene. A thermoplastic material, its mechanical properties are similar to those of polystyrene, but it has a higher softening point, about 130° C. The maximum temperature for continuous work in most applications is not less than 120° C. It can be processed like polystyrene, but temperatures must be raised by 30-60° C. Thin film can be extruded or cast, and an expandable form may soon be available that yields a foam readily withstanding boiling water.

Lucentine 82 is a thermoset plastic based on styrene and divinylbenzene, supplied in the form of rods from 0.25-3 inches in diameter and 9-15 inches long (up to four feet long, if specially ordered), and in sheets one foot square and ¼-1 inch thick. While dielectric constant and power factor are similar to polystyrene, heat resistance is much higher; up to 140° C. It is easier to machine than polystyrene. Resistance to solvents and to stress-cracking are excellent; oils and the like do not affect it. Another grade, Lucentine 91, not as temperature-resistant but somewhat tougher than the 82 grade, also is available, in addition to a grade 64 that has a higher softening point and is slightly more brittle.

Plastics in Spain

Spain had about 20 companies producing 6,454 metric tons of phenolic, urea, and PVC resin in 1955. Estimated figures for 1957 were 13,780 tons, of which 55% would be PVC. Several of the producers have plans underway for the manufacture of cellulose acetate, polyamides, polystyrene, and polyethylene, which heretofore had been imported. Industry sources have estimated the potential annual consumption of plastics materials to be approximately 23,000 tons.

About 1,000 plastics processors, with a capital investment of $48-million and employing 20,000 workers, were reported in 1956. Of these, 13 were considered large; half ranged from small to medium size; and the remainder were small handicraft shops. This represents a very rapid growth picture for the past decade.

Dollar shortages make it difficult to import materials and machinery from the United States, and imports amounted to a mere 88,068 kilograms in 1956. Imports and exports are subject to license by the Ministry of Commerce, and criteria considered in granting licenses include trade agreement commitments, availability of foreign exchange, and domestic production.

A new 5% "Use and Consumption Tax" has been assessed against domestically-produced as well as imported plastics materials. In addition, imports are subject to a so-called "Fondo de Retorno" surcharge of 25%. Several manufacturers hold patent rights granted by foreign countries, and technical information forms part of the collaboration programs involving production under such rights. The plastics department of the Patronato "Juan De La Cierva" de Investigacion Tecnica furnishes technical aid to domestic manufacturers, and also offers for sale patents which result from research conducted in its laboratories.

Plastics in West Germany

West German material output totaled 525,985 metric tons in 1956, a 23% increase over the previous year. Polymerizable materials such as PVC, PVA, polystyrene, polyethylene, and polymethacrylate set the pace with over 260,000 tons produced. No serious supply difficulties were experienced by materials producers, and increases of 7% in coke production and a 12% increase in oil refining upped supplies of coal tar- and petroleum-based raw materials.

Sales of plastic products increased from 958.6 million DM in 1955 to 1,172.1 million in 1956, for a 22.3% increase. A total of 110,034 tons valued 363,459,000 DM was exported in 1956, major markets being Netherlands, Austria, Switzerland, France, Italy, and Great Britain. Finished products were exported that year to a value of 11,738,000 DM.

Important to both the materials and the processing industries was the opening of the Deutsches Kunststoff Institut at Darmstadt in May, 1957. Dedicated to research and personnel training, its operations are coordinated with the Technical University of Darmstadt.

Vital ingredients for the PLASTICS INDUSTRY

METASAP VINYL STABILIZERS

—designed to give better protection from heat and light. Whether you are producing film, sheeting, floor tile or plastisols, there is a Metasap Stabilizer to do the job.

METASAP METALLIC SOAPS

—these proven compounds not only improve internal lubrication of molding powders, but act as plasticizers. When dusted on molds, they supply external lubrication and prevent sticking. They also permit molding at lower pressures, help speed the molding cycle, promote longer mold life, improve the finish of the end product.

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Remember, whatever your needs, you will fill them best—fill them fast—through Metasap. Write for full information. Our Technical Service Department will gladly make recommendations based upon your specific requests. Metasap Chemical Company, Harrison, N.J.

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New Materials

Write item numbers on Readers' Service Card to obtain more information.

Ultraviolet Absorber

A benzotriazole derivative which stabilizes plastics and other organic materials against discoloration and deterioration due to ultraviolet wavelengths, is being distributed in test quantities by Geigy Chemical Corp.'s industrial chemicals division. Tentatively named Ultraviolet Absorber CH3457, the stabilizer is transparent at use-concentrations but cuts off radiation at wavelengths below 3,900 Angstrom units.

CH3457 contains no carbonyl group and is inert to amine curing agents. It is stable to reducing agents, strong acids and alkalis, and is not affected by peroxide catalysts or other common chemicals commonly used in polymerization or plastics compounding. It will stabilize some dyes against light fading (frequently yellows); and may be incorporated in emulsion waxes, lacquers, and similar products, as well as in concentrated detergent solutions.

The stabilizer has been used successfully in polyesters, chlorinated polyesters, cellulose acetate, ethyl cellulose, alkyds, PVC, polystyrene, and acrylates. Stable to common processing temperatures the product may be added during polymerization, in the mill, or in the extruder. For thin films, concentrations of 0.5% or more may be required, while for structural plastics 0.25-0.5% is suggested.

Readers' Service Item 60

Self-Curing Adhesive

An all-purpose, synthetic copolymer adhesive for bonding metal, plastic, wood, glass, and other surfaces, has been developed and placed on the market by Rubba, Inc. Trade-named Rubbaweld, the material is a one-part adhesive which cures to a flexible, shock-resistant bond without heat, catalyst, or accelerators.

Unaffected by most oils, acids, and alkalies, the bond does not soften at high temperatures nor become brittle when cold. Rubberweld is applied by spray, coating machine, or brush to both surfaces which are to be cemented. When dry to the touch, the surfaces are joined together to bond instantaneously. A primer material is available for use where exceptionally strong adhesion is desired.

Readers' Service Item 61

Acrylic Appliance Finish

A thermosetting acrylic finish that heat-hardens to a tough, flexible film has been introduced by Interchemical Corp.'s finishes division. Trade-named Vitrilan, the finish is based on a cross-linking polymer which, unlike conventional acrylics, will not re-soften when heated and after cure is no longer soluble in its own solvents.

Designed for use on household appliances, Vitrilan exhibits exceptional resistance to soaps and other detergents; good color retention at temperatures up to 400° F.; outdoor durability; and resistance to moisture, acids, alkalies, and other chemicals. When subjected to a 1½% destructive detergent solution at 165° F., the finish showed no loss in film hardness, only minor blister formation, and a minimum reduction in gloss.

Vitrilan can be supplied to meet requirements for specific applications. It reduces with an aromatic hydrocarbon such as xylol, and a typical formulation would require one part, by volume, of reducer to four parts enamel. A bake of one-half hour at 350° F., is recommended to bring out maximum resistance in the finish, although a hard film can be achieved at 300° F. Over-bakes due to conveyor shut-down or oven temperature variations will not result in off-color rejects.

Readers' Service Item 62

Liquid Parting Films

Two liquid parting agents, consisting of polyvinyl alcohol in water-alcohol liquid media, are being marketed by Ferro Corp.'s color division. Trade-named Ferro V-264 and V-28, the materials are designed to facilitate the removal of polyester or epoxy parts from the mold. Due to their water-solubility, they are not recommended for use with water resin mediums.

Sprayed onto the base mold, they dry in 8-20 minutes to form a glossy film which will enable the plastic part to be separated from the mold. After the formed part is cured and taken from the mold, the film is removed by stripping or washing with warm water.

V-264 is colored royal blue to guide the sprayer in applying the proper film thickness for each molding operation; V-28 need not be removed because it is transparent. Both types are formulated to produce a glossy finish, although a matte film can be obtained if required in volume. They will adhere to sharp corners of the mold, and bridge-over such slight defects as scratches. When stored in sealed containers, the fluids have a shelf life of four to six months.

Readers' Service Item 63

Vinyl-Acrylic Emulsion

A vinyl-acrylic copolymer emulsion, trade-named Resyn 2203, has been added to the product line of National Starch Products, Inc. Intended for use in the textile industry for sizing purposes, the resin is said to impart a flexible finish which will maintain the glossy or lustrous characteristics of the material to which it is applied.

Resin 2203 is composed of fine, uniform particles which give good surface coverage and strong bonding properties. It is internally plasticized, odor-free, and has high oil and water resistance. Other properties include:

Solids, %	43
pH	6
Viscosity, cps	20
Avg. particle size, microns	0.1
Weight, lbs/gal	8.9

Readers' Service Item 64

Heat-Reactive Phenolic Resin

Solvent-type neoprene adhesives with high heat resistance now can be formulated with a heat-reactive phenolic resin recently introduced by Schenectady Varnish Co., Inc. Designated SP-126, the resin is soluble in aromatic, aliphatic, and ketone solvents; and is said to be compatible with both neoprene and nitrile rubbers.

The adhesive can be made by mixing the resin with solvent and pre-milled rubber, or by milling it into the rubber stock before cold cutting with solvent. The resin imparts fast air-drying as well as outstanding cohesive and adhesive properties to the formulation. Produced in lump form, SP-126 melts at 145-165° F. Depending on the end-use, up to 100 parts resin may be compounded with a maximum of 100 parts rubber.

Readers' Service Item 65

Two Fluoroalcohols

Research on the free radical telomerization of tetrafluoroethylene in methanol has led to the development of a new series of high solvency, fluorine-containing alcohols that can be used as plastics intermediates, surface active agents, lubricants, elastomers, and plasticizers. The two compounds, C_3 and C_5 fluoroalco-

hols, show excellent thermal and chemical stability. They may be obtained in developmental quantities from E. I. du Pont de Nemours & Co.

Clear, colorless liquids, the fluoroalcohols undergo reactions characteristic of primary alcohols, although their high acidity may require some modification of conditions normally used with hydrocarbon types if similar results are desired. They can be oxidized with potassium permanganate or nitric acid to produce corresponding fluorocarboxylic acids with boiling points ranging from 133-166° C., and unlimited solubility in water. Organic acid esters can be prepared by standard methods, and those derived from unsaturated acids readily polymerize into plastic or elastomeric materials. Polymers of the per-fluoroalkyl acrylates and methacrylates can be prepared by emulsion polymerization.

Diesters of the fluoroalcohols make superior lubricants and are less prone to fire and explosion hazards than are petroleum oils. High temperature lubrication can be accomplished with fluoroalcohol esters of polybasic acids. These compounds resist oxidation at temperatures up to 200° C., and are stable to pyrolysis at 300° C. Salts of phosphoric acid esters can be used as specialty surfactants particularly where conventional dispersants cause chain termination. Other promising derivatives include alcohol sulfates, fluoroalkyl urethanes and ethers, and tri (fluoroalkyl) cyanurates.

While the fluoroalcohols are of low toxicity, the company recommends good ventilation in areas where the chemicals are exposed to temperatures in excess of 200° C. Physical properties are as follows:

	C_3 Fluoro-alcohol	C_5-Fluoro-alcohol
Formula weight	132.06	232.08
Fluorine content, %	57.5	65.5
Melting point, °C.	—15	—
Boiling point, 760 mm. Hg., °C.	109-110	140-141
Density, 20° C., gm./ml.	1.4853	1.6647
Refractive index	1.3197	1.3178
Surface tension, 20° C., dynes/cm.	27.6	24.5

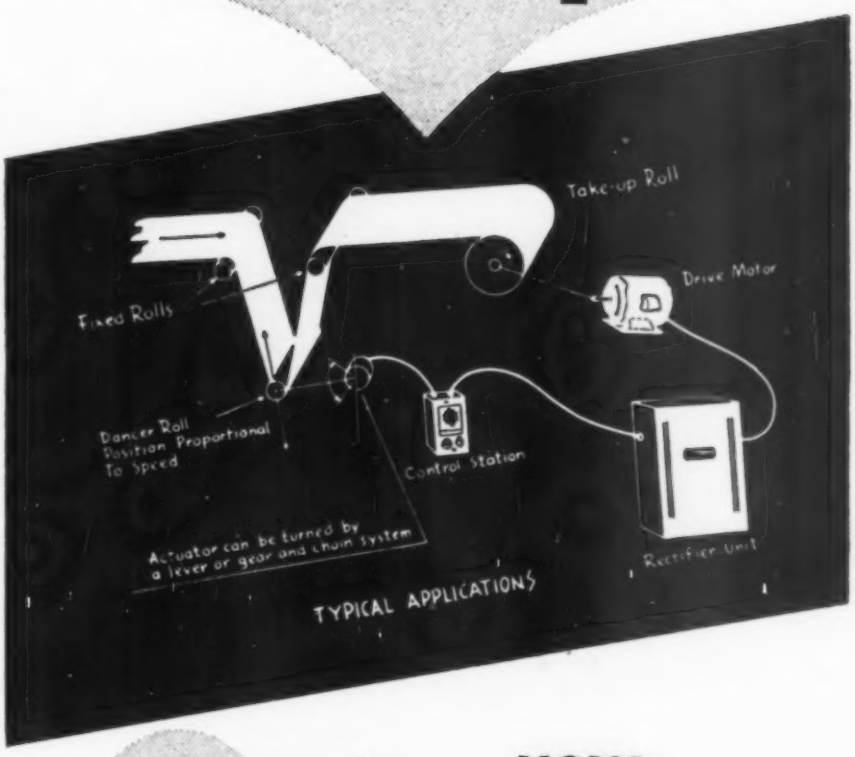
Readers' Service Item 66

PVC Plastisol Resin

A high-purity, PVC polymer, designed for use in plastisols and organosols, has been placed on the market by Goodyear Tire & Rubber Co.'s chemical division. Designated Pliovic VO, the polymer can be blended with Pliovic AO to provide a complete range of plastisol flow and fusion characteristics derived from the fast-fusion and pseudo-plasticity behaviour of the latter together with low viscosity and good shelf-life of the former.

Lack of residual soaps in VO reduces water absorption, and imparts a dry, non-greasy texture to fused compounds.

Servospeed
Automatic
Take-Up



Here's HOW IT WORKS ...for Textile and Plastics Processing

A small tension change positions the actuator shaft so as to call for motor speed change to restore preset tension. Thus a constant linear feet per minute windup may be achieved even though the radius of takeup roll increases with each turn to otherwise increase linear speed versus radius build-up. Speed is now made proportional to position of dancer roll and tension is held essentially constant, as is the linear rate of material travel.

These and other models of electronic motor speed control systems available from 1/50th to 2 horsepower.

WRITE

Servospeed
DIV. of ELECTRO DEVICES, Inc.
4 Godwin Ave. Paterson, N. J.

A 20-hour water immersion test at 158° F., showed a one percent gain in weight as compared to a 5-12% gain in weight for other dispersion resin compounds. This feature minimizes extraction of resin ingredients, helps maintain electrical properties, and eliminates haze formation.

Low viscosity and surface tension permit rapid deaeration of the plastisols to provide uniform, bubble-free cross-sections after fusion. Solvating and polymeric plasticizers can be used for improving compound properties and, since flow characteristics are retained for extended periods, intermittent use of specialty formulations is permitted.

Volume resistivity values of 10^{13} ohm-cm., observed in test formulations, indicate applications in the electrical field. Other recommended uses include rotational molding of flexible and rigid hollow products; scuff-resistant and decorative coatings for metals; and dip coating of household objects and industrial equipment requiring resistance to chemicals. Composed of 100% PVC, Pliovic VO has an inherent viscosity of 1.2 cps., and a bulk density of 25 pounds per cubic foot. Its average particle size is 1-2 microns.

Readers' Service Item 67

VANSTAY®

Vinyl heat and light stabilizers

Our trade mark of 12 years standing came into being with VANSTAY L, the first nontoxic light stabilizer for Vinyls.

Today, the VANSTAY line includes a number of materials developed to keep pace with Industry's demands for higher temperature Vinyl protection in process and in service.

Expanded research and technical service can be of immediate assistance in solving your Vinyl stabilization problems.

R. T. Vanderbilt Co., Inc.

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Fast-Grab Adhesive

Plastic laminates can be bonded without clamps or holding devices with Clair-Tact Adhesive 4570, a product of St. Clair Rubber Co. The adhesive grabs instantly to form a permanent bond, resistant to oil, grease, and water, and capable of withstanding temperatures above 212° F.

Creamy tan in color, Clair-Tact 4570 contains approximately 25% solids and is packed in brush or trowel consistency. It is applied to both surfaces of the laminate and permitted to dry 5-15 minutes, or until tack-free, before joining. Surfaces to be bonded must be clean and the adhesive should be brought to approximately 70° F prior to application. A highly flammable mixture, it should be applied in a well-ventilated area, away from spark-producing activity, glowing coals, and open flame. One gallon covers approximately 180 square feet, and use of diluents is not recommended.

Readers' Service Item 68

Three Mold Releases

Three improved mold release compounds, available in bulk or pressurized containers, have been placed on the market by Vin-Rock, Inc. Applied with spray, brush, or wiping-cloth, these release liquids dry to a hard, smooth, glossy finish that will not stain the stock nor affect its ultimate affinity for paint and cement.

Classified as type V-1 for injection molding, R-2 for compression molding, and Super XX for either application, these release agents are resistant to high temperatures and will not rust the mold. They are available in 12-ounce pressurized cans, one quart cans, and one, five, and 55-gallon drums.

Readers' Service Item 69

Non-Flammable Solvent

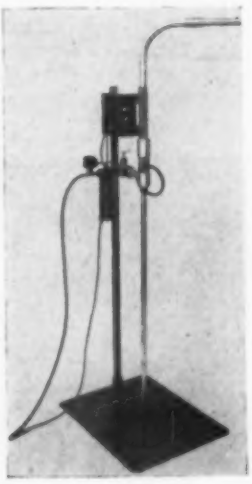
Epoxides, polyesters, polysulfides and silicone rubbers can be dissolved with Eccostrip 57, a non-flammable, free-flowing solvent, produced by Emerson & Cuming, Inc. It is applied with a cloth to remove surface coatings, or used as a bath for the recovery of items embedded in casting resins.

Plastic material absorbs the solvent, swells, and starts to flake. The process may be accelerated by periodically removing loosened material. Excess solvent may be strained and re-used.

Readers' Service Item 70

New Equipment

Write item numbers on Readers' Service Card to obtain more information.



Filter cone attachment for Whitlock Series 1000 hopper loader for dry-colored plastic materials.

Hopper Loader Attachment

A hopper loader attachment, said to solve the dust problem in the handling of dry-coloring materials, has been placed on the market by C. H. Whitlock Associates. Intended for use with the company's Series 1000 hopper loader, the attachment consists of a round aluminum weldment that is attached to the end of the conveyor tube directly over the hopper and holds a conical-shaped filter. The filter cone is installed so that the smaller end extends down into the throat of the hopper.

In operation, the filter is loaded about half-full of the material being processed. As the material is used, it drops down through the bottom of the cone into the hopper throat, and is replenished in the cone by the hopper loader. The upper part of the filter cone acts to filter the dust which collects on the inner surface of the cone. The cones are replaceable at low cost. The attachment enables the hopper loader to be used with any dry-colored plastic material prior to extrusion or injection molding.

Readers' Service Item 71

Magnetic Grating

Magnetic grate assemblies, designed to remove ferrous material from flowing grain, powder or liquid, are being built on a custom basis by Soules Magnetics, Ltd. Consisting of parallel brass tubes containing General Electric's permanent rod magnets, the assembly is placed in the path of material flow where it attracts and holds entrained metal particles. The particles usually accumulate on the under side of the tubes where they are protected from the flow.

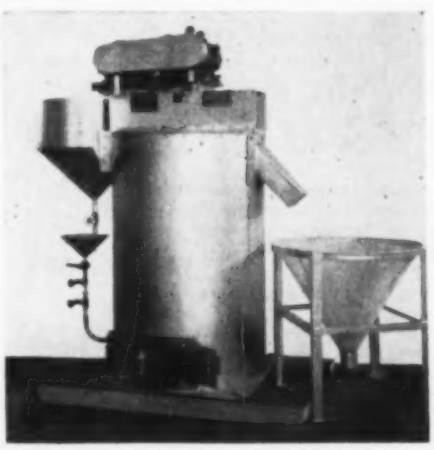
These units have been particularly successful in eliminating fires in pigment processing where steel particles produced sparks in passing through the pulverizer. Primarily three sizes of tubing are used, ranging in diameter from ⅝-1¼ inches. Each size contains progressively larger and more powerful magnets.

Readers' Service Item 72

Pre-Expander for Polystyrene

Polystyrene beads can be enlarged to permit shorter molding cycles and fabrication of lower density finished products with use of the Rodman Steam Pre-Expander developed by Koppers Co., Inc. While prototyped in Koppers' laboratories, the first commercial model was built by Artisan Metal Products, Inc., and has given continuous, trouble-free service since March 1957. At present Artisan and the F. F. Slocomb Co. are licensed to manufacture this equipment.

In operation, steam and raw beads are fed under atmospheric pressure into a stainless steel, cylindrical drum. The beads are agitated by a stirring mechanism and, as they expand, are displaced upwards to spill out through an overflow chute. The expanded beads fall into an aluminum screen receiving hopper from which they



Rodman Steam Pre-Expander

Xaloy

BIMETALLIC EXTRUDER CYLINDERS
original and replacement equipment

specified for

EVERY TYPE EXTRUDER

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are air-conveyed to a storage bin or directly to the molding machine.

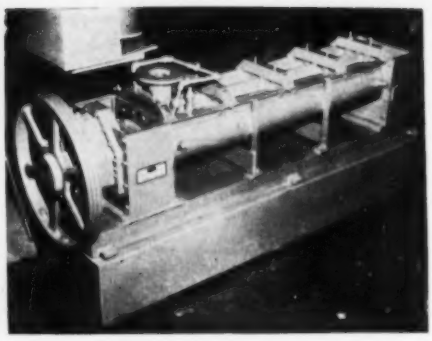
In case of power failure, two solenoid valves cut off bead feed, shut off steam flow, flush out the bead feeder assembly, and inject cold water into the drum to stop the pre-expanding action.

Two models are available requiring three and five horsepower prime movers. The smaller unit delivers expanded beads at rates up to 300 pounds per hour, while the larger has a capacity up to 400 pounds per hour. Equipment furnished with a standard installation includes: stainless steel agitating drum whose inside diameter is 32 inches, depth 60 inches; galvanized steel bead feeder hopper; steam jet bead feeder piping assembly with soleniod shutoff valves; and aluminum screen receiving hopper. An ammeter is wired into the agitator electric motor circuit to serve as a check on overloads.

Readers' Service Item 73

Continuous Mixer

Homogeneous mixes of high density or high viscosity materials can be obtained with a double-arm continuous mixer recently developed by Read Standard Division, Capitol Products Corp. Designed for heavy duty applications in the process piping system, this machine will blend materials with apparent viscosities up to 100,000 cps.



Readco double-arm continuous mixer.

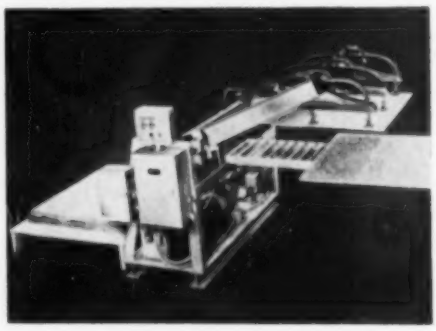
The mixer can be equipped for vacuum operation and with temperature controlling jackets for heating or cooling. Close tolerances between the rotating blades and the bowl produce high shear rates and a violent mixing action, thus making the machine suitable for use as a reaction vessel or crystallizer. Through-put rates range up to four cubic feet per minute, while material retention in the chamber varies from 30 seconds to five minutes.

Readers' Service Item 74

Automatic Sheet Feeder

Flat and corrugated plastic sheets can be transferred from pile to processing equipment or vice-versa with an automatic, over-arm, sheet feeder and piler recently developed by de Florez Co., Inc. Designed for manual or automatic operation, this machine will handle sheets as large as six by 15 feet, at rates up to 15 sheets per minute.

The feeder incorporates a suction cup carrier which is pivotally mounted between the arms of a transfer frame. The frame is powered through a heavy-duty roller chain by a geared, reversible, brake-motor. Compensating springs dampen vibration and reduce the inertia load on the motor to provide smooth accelerations and decelerations.



De Florez automatic sheet feeder.

As the frame oscillates, it lowers the vacuum cup carrier until it engages a sheet. Upon contact, a sensing switch activates the vacuum system so that the cups grasp the sheet. At the same time the drive motor is reversed, thus rotating the transfer frame and carrier to the delivery side of the machine. When the carrier reaches a predetermined position, its motion is stopped, and the sheet is discharged. If set for automatic operation, the frame will return for another load.

Fixed or adjustable cups are spaced on the transfer frame to prevent sag in the sheet. The machine can stack piles up to 48 inches high, and sheet-deliveries can be made horizontally, vertically, or at any other angular attitude.

Readers' Service Item 75

Barrel Finishing Machines

Barrel finishing machines with cylinder capacities ranging from five to 25 cubic feet now are available from Crandall Engineering & Mfg., Inc. Designated the No. 30 Series, which includes a total of 15 models, these units are fully enclosed by a solid top and a slide-away front closure extending below the cylinder. Where possible, standard parts are used in the assembly to facilitate maintenance.

Cylinders are made of plate steel and lined with calendered neoprene to prevent leakage. Quarter-inch steel is used in the housing, while structural channel members reinforce the legs to eliminate need for

Your fast way of pre-determining the weathering qualities of a Plastic is in the ATLAS WEATHER-OMETER®

Test for resistance to sunlight, moisture, and thermal shock.
Results are accurate and reliable and can be reproduced precisely over and over again.
The Weather-Ometer furnishes a yard stick to measure the improved quality of a plastic in development and to maintain a standard of quality in production.
Automatic control of light, moisture, and temperature, can be set for repeating cycles according to the test program selected. A year of destructive weathering can be reduced to a few weeks of testing in the Weather-Ometer.

For Color Fastness only — use the Atlas Fade-Ometer®. Fully automatic in operation.

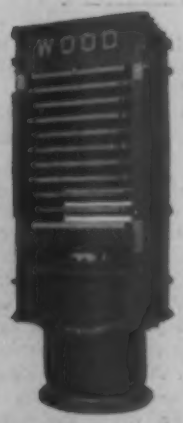
Write for technical information and recommendations for your particular problem.

ATLAS ELECTRIC DEVICES CO., 4114 N. Ravenswood Ave., Chicago 13, Illinois

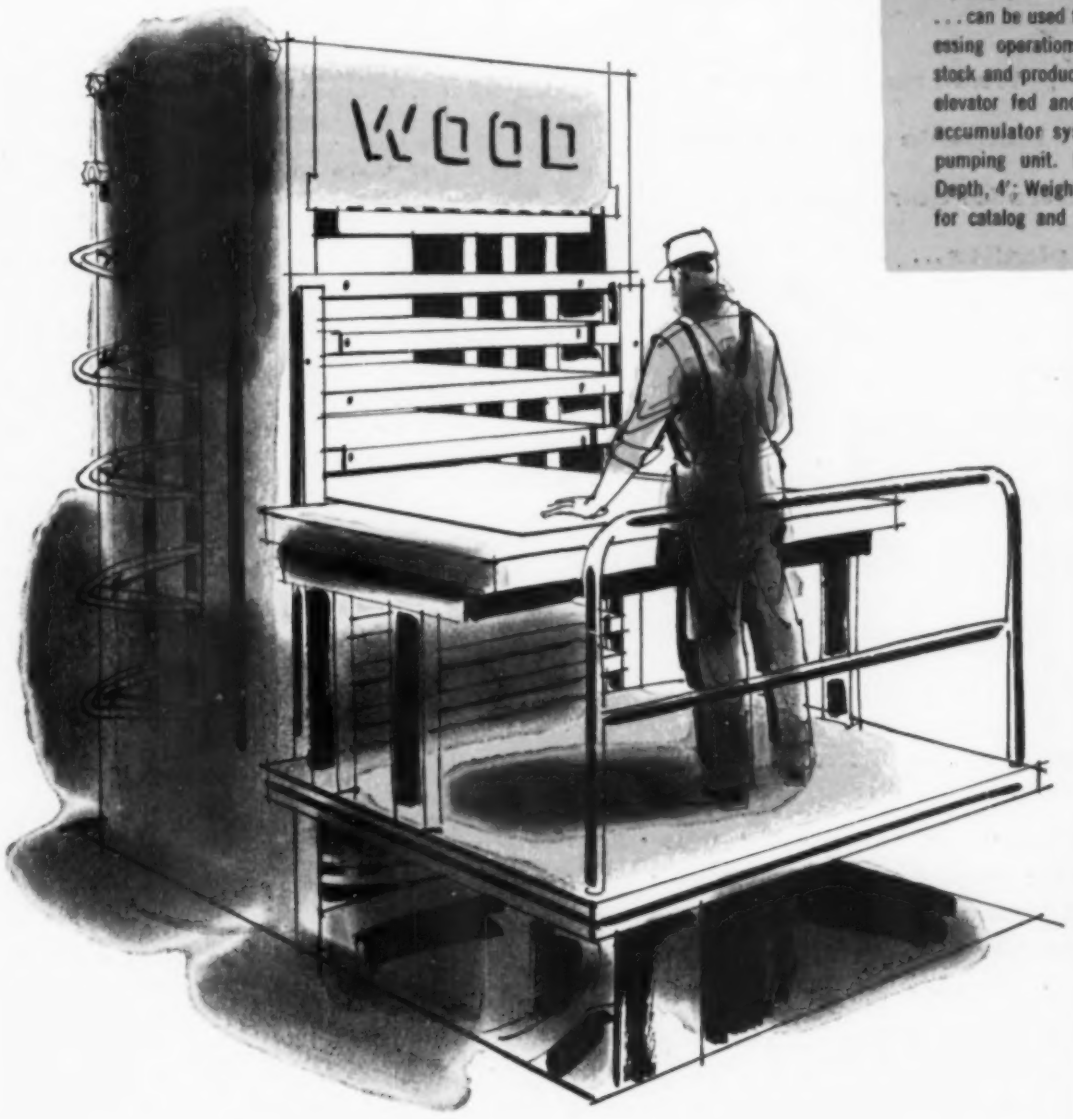
WEATHER-OMETERS® • FADE-OMETERS® • LAUNDER-OMETERS®

Apply your special requirements to basic R. D. Wood press designs

Here's the sensible, economical way to design your own press. Working with numerous *basic* models, R. D. Wood engineers apply *your* specifications and modifications to produce the press precisely suited to your needs. No starting from scratch. No needless delays in construction. No paying for more design than you need. You're sure of quality too. For every Wood press is constructed of selected materials by master craftsmen. Here is your assurance of precise operation and long, trouble-free performance. When you need a press, bring your specifications to Wood.



R. D. Wood 10-opening, hydraulic platen press for the production of molded cellular rubber and plastics products. This 1100-ton capacity press has platens—42"x42"x2½" . . . can be used for general purpose processing operations such as curbing slab stock and producing floor tile. Machine is elevator fed and can be used with an accumulator system or self-contained pumping unit. Height, 14'; Width, 5'; Depth, 4'; Weight, 80,000 lbs. Write today for catalog and engineering information.

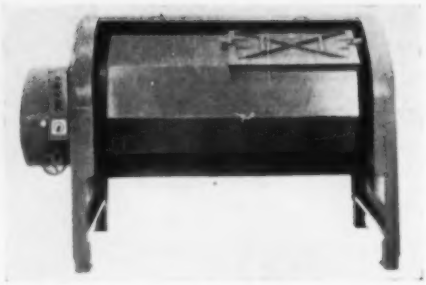


R. D. WOOD COMPANY

PUBLIC LEDGER BUILDING • PHILADELPHIA 5, PENNSYLVANIA

special foundations. The drive motor is a standard NEMA re-rated 1,800 rpm. unit of one to five hp. output, according to machine size. Power is transmitted through an oversize, vari-speed, V-belt drive system which helps to eliminate shock and vibration.

Push-button controls, located on the left side of the machine, permit the operator to inch the cylinder forward or backward while loading. Other safety features include: fully enclosed motor and drive; a safety pressure release; and a 110-volt control circuit, fused to eliminate short circuit hazards. A magnetic disc brake is connected to the cylinder to prevent unexpected rotation when the power is off or the drive belt removed.



Crandall No. 30 Series finishing machine.

Over-all dimensions common to the entire series include: height, 60 inches; and depth, 56 inches. Over-all length varies from 48½-96½ inches while cylinder lengths vary from 12-60 inches.

Readers' Service Item 76

Two Test Instruments

Arc and track resistance of plastics and other insulating materials can be evaluated with the Model 126 Arc Resistance Tester, recently developed and placed on the market by Delsen Corp. The instrument is used to measure resistance to high-voltage, low current arcs and is supplied in accordance with ASTM Specification D495-56T and Federal Specification L-P-406b, Method 4011.2.

Model 126 features a built-in timer to indicate arc resistance time, and a specimen holder which automatically levels and sets the correct electrode pressure. The electrode assembly is easily cleaned and is interlocked to insure operator safety. It is surrounded by a transparent enclosure which permits visibility during tests, and protects the arc from air currents.

Delsen manufactures also, a portable, non-destructive, direct reading instrument which measures the dissipation factor and dielectric constant of insulating materials. Known as the D-K Analyzer, the unit can be used to investigate the effects of variables such as hardeners, fillers, and cure conditions in dielectric systems. It detects non-uniformities in the electrical properties of insulators, and can monitor the output of such continuously-operating devices as coating machines, or check parts going into service without the necessity of removing dummy coupons from the stock.

Available for battery or plug-in power source, the D-K Analyzer can make several hundred measurements per hour. No calculations are required and access to the system need only be from one side.

Readers' Service Item 77

In Brief . . .

Hamilton Division, Hamilton, O., of Baldwin-Lima-Hamilton Corp., has appointed Addy & Goetz Machinery Co., Cleveland, O., as a distributor for its presses. The A & G sales territory includes Northern Ohio, Western Pennsylvania, and West Virginia, and the firm will sell all types and sizes of Hamilton and Baldwin hydraulic presses, including plastics types.

Akron Chemical Co., Akron, O., is handling sales and service of Hooker Electrochemical Co.'s Durez Plastics Division's phenolic resins to the rubber industry in Ohio, Indiana, Michigan, Western Pennsylvania, and Western New York.

When the problem is inorganic pigments and extenders for compounding plastics...

WILLIAMS invites you to take advantage of its 80 YEARS EXPERIENCE

Today Williams offers a complete line of inorganic pigments and extenders for the plastics industry. All have color permanence and chemical stability. Here is a representative list of these products.

Pure Red Iron Oxides • Pure Yellow Iron Oxides • Pure Black Iron Oxides • Pure Brown Iron Oxides • Pure Chromium Oxide Greens • Pure Hydrated Chromium Oxides • Umbers • Siennas • Lampblack • Anhydrous Calcium Sulfate • Barytes • Calcium Carbonates

Send today for detailed Technical Reports which give you complete description of the chemical and physical properties of each. Address Department 37, C. K. Williams & Co., 640 N. 13th Street, Easton, Pennsylvania.

WILLIAMS
COLORS & PIGMENTS
C. K. WILLIAMS & CO.
E. St. Louis, Illinois • Easton, Pennsylvania • Emeryville, California

THEY WANT IT CLEAR

...YOU WANT ADVANCE

Mom says—"Don't hide that colorful, fresh, new upholstery." But Dad says—"Let's keep it looking that way."

How to have their cover and see the color underneath, too? . . . Answer: Clear, plastic seat covers. But they do mean clear. So, when it comes to stabilizers, specify the **BC-100** system. This **Advastab** stabilizer is an all-around performing barium-cadmium system. When your product requires H_2S stain resistance add **Advastab Z-6 WW.** If your product is one, such as transparent seat covers, **CH-300** will give the superb clarity your customers demand. Together . : . as a 3-product combination . . . these can't be equalled.

Together they can solve almost any of the problems associated with stabilization – whether it be calendering, extrusion or plastisols. Even the very touchy, thin-gauge calendered job is free from color drift. Even if it's an extrusion through cross-head dies you'll enjoy longer runs between shutdowns. Or, if it's one of those brow-wrinkling plastisol jobs the **ADVANCE BC-100** system provides excellent air release and viscosity control, both initially and for long term aging.

Companies who have switched to **BC-100** are finding they usually drop their stabilizer cost over 10%. Let's talk about your stabilizer system. Samples, data and our technical development staff are at your disposal. For a comprehensive listing of other **ADVANCE** products see our insert in the Chemical Materials Catalog. Write or call. And if you telephone we have always assumed you felt free to do so collect.

The above mentioned stabilizers and many others, including a full line of organo-tins such as **T-52N, T-17M** and **T-72,** are available from **ADVANCE SOLVENTS & CHEMICAL,** 500-2 Jersey Avenue, New Brunswick, New Jersey . . . and from . . .

Advance International Ltd.,
245 Fifth Avenue, New York 16, New York

Advance Solvents & Chemical
Corp. of Canada, Ltd.,
Montreal and Toronto

and from our Manufacturing Affiliate . . .

Deutsche Advance Produktion G M B H
Marienberg Bei Bensheim
(Bergstrasse)
Western Germany

DIVISION OF CARLISLE CHEMICAL WORKS, INC.

ADVANCE

Plastics Applications

Write item numbers on Readers' Service Card to obtain more information.

Porta-Bell TV set has a lightweight reinforced-plastic cabinet.

Polyester-Glass TV Cabinet

The 1958 line of portable TV models produced by Packard-Bell Electronics Corp., features a reinforced-plastic cabinet molded from preforms by Minnesota Mining & Mfg. Co. In addition to good acoustical properties, the non-conducting cabinet is both rugged and lightweight. The preform method is said to impart greater strength and durability since the glass fibers are distributed more uniformly. This results in a more favorable strength-to-weight ratio.

The set itself is called the Porta-Bell. It has a 17-inch screen, power transformer, and an acrylic filter safety lens for improving contrast and reducing glare and reflection. Color is mixed into the uncured resin and, therefore, cannot be scraped off. Three color combinations are available: charcoal, mocha, and torquoise; each with white trim.

Readers' Service Item 80

Wire Varnish-Enamel System

Two polyester materials, one an electrical-insulating varnish and the other a wire enamel, have been introduced by Schenectady Varnish Co., Inc. Used together, they permit sustained operation at 180° C.

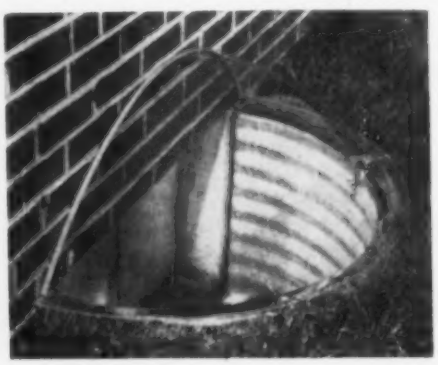
Isonel No. 31 High Bonding Varnish cures at normal baking temperatures of 290-325° F, and is highly resistant to hot oil, water, acids, and alkalis. Properties of the cured varnish are reportedly excellent in the following respects: bond strength, toughness, adhesion, and penetration. Specifications are reported below:

Viscosity at 25° C., cps.	235-300
Ford cup #4, seconds	80-110
Specific gravity	0.925-0.935
Baume	21.3-19.8
Color	Clear
Solids content, %	46-50
Solvent	Xylol
Flash point, °F.	80

Isonel No. 175 Wire Enamel has excellent adhesion to most insulating varnishes and is recommended for such applications as high-temperature, high-speed tool motors. Its life is approximately 30,000 hours at 170° C. (unvarnished specimen), at 180° C. combined with Isonel No. 31. The enamel will pass 30-40 scrapes on a G-E Scrape Abrasion Tester using a No. 11 needle weighted with 700 grams. Subjected to the NEMA Sanp test, the enameled wire can be parted by a rapid snap without losing adhesion or cracking at the point of break. Viscosity and solids content are available for die application on all types of enameling equipment.

Readers' Service Item 81

Basement Window-Well Canopy



Acrylic dome protects window wells from refuse and the elements.

A transparent acrylic canopy for basement window wells has been introduced by Accro Plastics. Called the Accro-Dome, the device allows full light passage while keeping the wells free from leaves rain, snow, and the like.

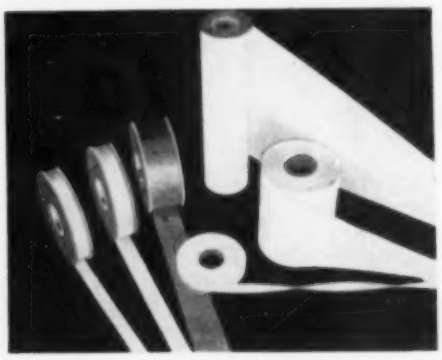
Accro-Domes measure 44 inches wide, 22 inches deep, and 11 inches high. They are held in place by two wire brackets which are bolted through two holes drilled in the corrugated metal well-liner. A plastic weather seal applied to the dome's back edge fits tightly against the side of the building. An air space under the rim allows free ventilation. Acrylic material used in this application is Plexiglas, a product of Rohm & Haas Co.

Readers' Service Item 82

Color-Coded Teflon Tapes

Polymer Corp. of Pennsylvania's Polypenco Teflon tapes are now available in ten coded colors, and in thicknesses ranging from 1-125 mils. Maintaining very closely the electrical properties of natural Teflon tapes, the colored products exceed the aeronautical materials specification No. 3652 for polytetrafluoroethylene tapes and films.

Color is incorporated directly into the tape for homogeneity. Available in widths of ¼-12 inches, the tape is used for wrapping of hook-up wire, thermocouple wire, coaxial cables, generators, transformers, coils, and the like. It has a service temperature range of —320 to +500° F., zero water absorption, and is chemically inert.



Colored Teflon-tape sampling.

Readers' Service Item 83

Plastic Pipe-Line Insulator

Glass fiber-reinforced polyester pipeline insulators are being compression molded at high temperatures and pressures by F. H. Maloney Co. Designed to

Reinforced plastic pipe-line insulator.

absorb load shocks and provide cathodic protection at pipe line crossings, the Model 57 insulator is available in sizes of 2-36 inches. It is ribbed inside to prevent cold flow of pipe wrap, and has been tested at pressures in excess of 18 tons, and temperatures in excess of 400° F. (boiling hot pitch).

Readers' Service Item 84

Corrosive Liquids Container

Chemco Photoproducts Co., is now packaging its Powerfix and Powerlith 317 Plate Etch in a five-gallon polyethylene container. Called the Cubitainer, it is shipped in a heavy-duty corrugated box which is provided with hand grips for easy pouring. An integral polyethylene spout folds when not in use.

The complete unit measures 12½ by 12½ inches, and stands 12 inches high. Corrosion-resistant and break-proof, it requires less storage space than conventional glass bottles or drums.

"Cutaway" shows polyethylene container.

Readers' Service Item 85

Plasticizer Data
TO HELP YOU CHOOSE THE RIGHT PLASTICIZER

this
Harflex® Plasticizer
is efficient

Dimethyl sebacate

extreme efficiency • excellent low temperature properties

Appearance	Clear Liquid or White Solid
Color, APHA	100 max.
Odor	Neutral
Specific Gravity 30/20°C	0.986±0.003
Free Acidity, as Acetic Acid	0.02 max.
Ester Content	99.0% min.

major uses:

A plasticizer in vinyl resins, synthetic rubbers, cellulose nitrate, cellulose acetobutyrate, acrylic resins; as a chemical intermediate, and a neutral, concentrated source of the sebacyl radical.

Harchem produces a full line of phthalate, adipate, sebacate and polymeric plasticizers. The Harchem Division laboratories will gladly assist you with your plasticizer problems, or will supply additional data including formulation test results and formulation suggestions for any Harflex Plasticizer.

Additional Inquiries to Dept. H-41.73

THE KEY TO HARCHEM® BETTER PLASTICS

HARCHEM DIVISION
WALLACE & TIERNAN, INC.
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY
IN CANADA: W. C. HARDESTY CO. OF CANADA, LTD., TORONTO

MERCHEN GRAVIMETRIC FEEDERS & METERS

for dry free-flowing materials

- automatic batch control
- continuous blending
- materials accounting

Accuracy 1%
Rates 3 to 3000 lbs. per min.

Write for Bulletin No. M-32.73

M-32

WALLACE & TIERNAN
INCORPORATED
25 MAIN ST., BELLEVILLE 9, N. J.

SMD-3500

A free-flowing polystyrene compound offering both excellent moldability and fast set-up. Along with low bulk factor, this material provides good electrical, mechanical and optical properties. Widely used for injection molding operations.

TMDA-6000

A high-impact, rubber-modified polystyrene with low bulk factor, free flow and quick set-up. Izod impact strength is as much as 5 times that of general-purpose styrenes.

TMDA-9001

Good flow and fast set-up are combined in this medium-impact, rubber-modified polystyrene. Surface gloss and translucency are excellent. Widely used for caps, closures and containers.

RMD-4511

Possesses exceptional resistance to chemicals and high heat, as well as unusual flexural and tensile strength properties. These make this acrylonitrile-styrene copolymer ideal for surface hardness, dimensional stability and rigidity in service.

TMDB-5161

In addition to a high heat distortion point, this high-impact, rubber-modified polystyrene affords superior mechanical strength and good electrical properties. An outstanding material for radio cabinets and similar applications. Molds with good flow and release; set-up is fast; surface gloss is superior; colors are excellent.

TMDB-2155

A rubber-modified polystyrene with extra-high impact strength even at temperatures of −25° C. **Strongest rubber-modified styrene on the market today!** Molding properties are excellent; ease of flow at molding temperatures; fast cycles; good mold release; and a minimum of strains and weld lines.

Which styrene would you choose for this product?

"BAKELITE" PLASTICS
BRAND

THE PRODUCT:

Domestic food waste disposer encased in a sound-deadening, molded plastic shell. Designed by Waste King Corporation, this "Super Hush" model is quieter—lighter, easier to install—combines attractive colors with durability. Molded by Industrial Molding Corp., Culver City, Calif. and Modern Plastic Co., Los Angeles, Calif.

THE PROBLEM:

Pick a plastic which affords ease of molding to the "sculptured" design desired. In addition, provide for chemical inertness, resistance to heat, and excellence of color and lustre. Above all, provide for durability in service with properties of high impact strength.

THE SOLUTION...

to this manufacturing problem is in the *wide selection* of BAKELITE Brand Polystyrenes. If you selected TMDB-5161 as your choice for this "Waste King" Pulverator you matched up properties to performance requirements *exactly* as countless of fabricators are doing every day with BAKELITE Brand Plastics.

For the right styrene to meet *your* needs exactly, discover the full range of BAKELITE Brand compounds. And, to assist you in your selection, call on the services of your Bakelite Company Technical Representative—or write Dept. HQ-29G.

In addition to the styrene molding materials described at left, Bakelite Company provides for your selection these others:

SMD-3000 (unmodified heat-resistant Styrene)
SMD-3700 (high-flow Styrene for containers)
RMD-4500 (high-clarity Acrylonitrile-Styrene)

VINYLS • EPOXIES • STYRENES
C-11 STYRENES • PHENOLICS
POLYETHYLENES • IMPACT STYRENES

Products of UNION CARBIDE *Corporation*

BAKELITE COMPANY, *Division of Union Carbide Corporation,* 30 East 42nd Street, New York 17, N. Y.
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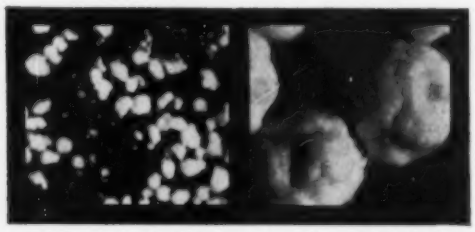
The terms BAKELITE and UNION CARBIDE are registered trade-marks of UCC.

WHY ESCAMBIA PVC RESINS MEAN MORE PROFIT FOR YOU

Outstanding product advantages to help you satisfy present customers—sell new ones.
Production benefits to save you money—increase your profits.

ESCAMBIA PVC PEARLS



Conventional PVC *Escambia PVC Pearls*
(Each magnified 20 times)

A unique new polymer characterized by large, uniform particle size and COMPLETE FREEDOM FROM FINES. Their extraordinary capacity to absorb unusually large amounts of plasticizer gives you UNIFORM AND FREE FLOWING DRY BLENDS at high plasticizer levels. EXCEPTIONAL HEAT STABILITY enables you to extrude medical tubing and other critical non-toxic applications with no metallic stabilizers from a dry blend. Here are some processing advantages you get with these resins: Very low gel count, excellent color and clarity, dust-free handling, extremely fast dry blend flow properties, and fast extrusion rates. ESCAMBIA PVC PEARLS are manufactured in four molecular weights covering all general purpose and many specific applications.

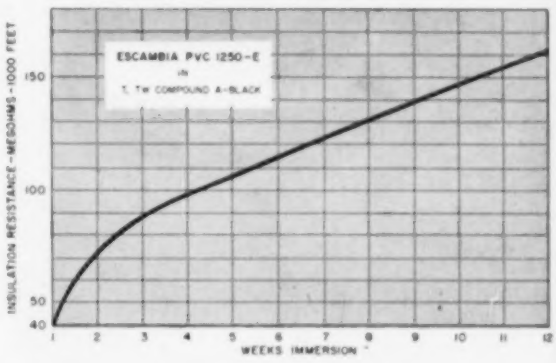
ESCAMBIA ELECTRICAL GRADE PVC RESINS

FOUR electrical grade PVC resins in this series give you a full range of molecular weights from ONE manufacturer—enable you to:

- Meet your most difficult specifications
- Operate at your most efficient speeds and temperatures
- Produce outstanding electrical products

You are now able to choose the molecular weight best suited to your own operating conditions. These resins give you free-flowing dry blends, extremely low gel count, freedom from fines, uniform particle size, excellent color and clarity and outstanding insulation resistance.

INSULATION RESISTANCE IN WATER AT 50°C
NO. 14 AWG WIRE, 1/32" INSULATION



ESCAMBIA GENERAL PURPOSE PVC RESINS

These general purpose PVC resins deliver money saving benefits to your plant.

- Free-flowing dry blends
- Extremely low gel count
- Excellent color and clarity
- Uniform particle size
- Freedom from fines
- Outstanding heat stability

This series is manufactured in four molecular weights.

HELP YOURSELF TO THE PROFIT-MAKING ADVANTAGES YOU GET FROM THESE RESINS—
Write or Call for samples and specifications—

ESCAMBIA CHEMICAL CORPORATION
261 MADISON AVENUE • NEW YORK 16, N. Y.
NEW YORK TELEPHONE • OXFORD 7-4315

MANUFACTURERS OF: ESCAMBIA P V C PEARLS* / ESCAMBIA PVC RESINS / BAY-SOL* (NITROGEN SOLUTIONS) / AMMO-NITE* (PRILLED AMMONIUM NITRATE FERTILIZER) / ANHYDROUS AMMONIA / AMMONIA / NITRIC ACID / METHANOL
*TRADEMARKS OF ESCAMBIA CHEMICAL CORPORATION

New Literature

Write item numbers on Readers' Service card to obtain copies.

"Ross Constant Temperature and Humidity Unit." Bulletin No. 61. J. O. Ross Engineering division of Midland-Ross Corp. 4 pages. The firm's self-contained control unit is described and illustrated along with accessory equipment and method of operation.

Readers' Service Item 90

"Eye Appeal—Key to Increased Sales." Technical Bulletin No. 47 P. Claremont Pigment Dispersion Corp. 1 page. D-4758 synthetic pearl paste for vinyls is described in this bulletin.

Readers' Service Item 91

"Carwin Products Catalog." Carwin Co. 28 pages. Described herein is the company's line of chemical intermediates for the dyestuff, pigment, and pharmaceutical industries; as well as isocyanates for urethane foams, adhesives, and other uses.

Readers' Service Item 92

"Picturegram of Money-Saving Ideas in Deflashing Plastics." Wheelabrator Corp. 8 pages. Pictures showing how four plastics manufacturers solved deflashing problems with Wheelabrator equipment—production rates and cost figures are included.

Readers' Service Item 93

"Precision Machines for Marking, Embossing, Printing, and Decorating." Ackerman-Gould Co. 4 pages. This king-size, illustrated brochure describes the firm's line of six basic- and 16 special-model machines for accomplishing the above-mentioned operations.

Readers' Service Item 94

"Ace Acrylic Rods, Tubes, and Shapes." Ace Plastics Co. 2 pages. This illustrated circular describes the company's stock extrusions, listing diameters, wall sizes, weights, and tolerances.

Readers' Service Item 95

"The Electrical Properties of Lexan Polycarbonate Resin." General Electric Co., Chemical Development Department. 6 pages. In addition to listing electrical properties, this bulletin suggests such uses for Lexan as coil forms, varnish ingredient for coating conductors, and panels for electronic equipment.

Readers' Service Item 96

"Machining and Mechanical Finishing of Lexan Polycarbonate Resin." General Electric Co., Chemical Development Department. 5 pages. Though a thermoplastic, Lexan has a high melting point and, therefore, little tendency to soften or gum during machining. A few of the standard operations are described in the bulletin.

Readers' Service Item 97

"Pressure-Sensitive Tapes." Dow Corning Corp. 6 pages. Made with silicone adhesives, the tapes will stick at temperatures of 110-550° F. They are made with ten different backings, choice depending upon desired usage.

Readers' Service Item 98

"Lexan Molding Compound—A New Thermoplastic Resin." General Electric Co., Chemical Development Department. 4 pages. Properties and uses are described and listed in this brochure.

Readers' Service Item 99

"Solution Coating with Lexan Polycarbonate Resin." General Electric Co., Chemical Development Department. 1 page. Solvents, formulas, and techniques for getting the material into solution are discussed.

Readers' Service Item 100

"Injection Molding of Lexan Polycarbonate Resin." General Electric Co., Chemical Development Department. 6 pages. Pre-injection handling, molds, molding temperatures, suggested nozzle design, and molding cycles are described in some detail.

Readers' Service Item 101

"Richardson PCR Control." Product Data Sheet 5705. Richardson Scale Co. 2 pages. The flyer describes a new punched card reader for the automatic control of blending, batching, and proportioning operations.

Readers' Service Item 102

"General Instructions for Tooling with Eccobild Resins." Technical Bulletin 20-1. Emerson & Cuming, Inc. 4 pages. This bulletin covers pattern preparation, laminated tools, cast tools, and drop hammer dies and punches.

Readers' Service Item 103

"Research in Chemical Processing." Battelle Memorial Institute. 18 pages. This illustrated booklet describes the firm's facilities and gives case histories of its service to various firms in solving chemical processing problems.

Readers' Service Item 104

FINELY GROUND

MICA FILLERS

Increased strength . . . high impact resistance . . . compatible with all resins . . . and best thermal and electrical properties of any mineral filler. It is transparent, tough, flexible and chemically inert.

50 YEARS OF PRODUCING FINELY GROUND MICA

The English Mica Co.
STERLING BUILDING STAMFORD CONN.

Book Reviews

"British Plastics Year Book 1958." 28th Edition. Iliffe & Sons, Ltd., Dorset House, Stamford St., London S.E. 1, England. Cloth, 6¼ by 9¼ inches, 816 pages. Price, 42 Shillings (currently, $5.94).

Exactly 100 pages have been added to this edition of the classified guide to plastics manufacturers and products in the United Kingdom. It contains nine tabbed sections, each revised from earlier editions. Three sections list manufacturers of raw materials, products, and equipment; another section deals with proprietary names and technical terms used in the industry; and over 4,000 firms are listed in the names and addresses section.

Who's Who in the plastics industry records the names and positions of prominent men in the British plastics industry. Still another feature is the section on patents, new companies, and specifications. Patents are reviewed according to subject group. A technical and general data section is included, as is a general index.

"Industrial Chemica's." 2nd Edition. W. L. Faith, Donald B. Keyes, and Ronald L. Clark. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. Cloth, 6¼ by 9½ inches, 853 pages. Price, $16.00.

Forty chapters cover 40 different chemicals, how they are made, the reaction involved, material requirements, the process or processes, 20-year production figures and price ranges, properties, grades available, packing and shipping information, manufacturers, and economic trends.

Schematic drawings are included to show the actual commercial process. Amounts of materials used are given, and the bulk of the information for each chapter is descriptive matter on the processes involved. The only change in form from the first edition is a listing of names and locations of manufacturing plants, rather than the maps previously used.

"Textile Chemicals and Auxiliaries." 2nd Edition. Edited by Henry C. Speel and E. W. K. Schwarz. Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. Cloth, 6 by 9¼ inches, 551 pages. Price, $13.50.

All commercially-important chemicals used in the processing of textiles are described in this book. Though not of direct interest to the plastics processing industry, it contains a very interesting chapter on synthetic resins. Thermosetting resins are more widely used in the textile industry than are the thermoplastics; generally for impregnation to provide crease resistance, shrinkage control, and for the binding-in of pigments and starches. These include the ureas, melamines, phenolics, acetone-formaldehydes, alkyds, epoxies, polyurethanes, silicones, and ethylene-imine derivatives. Thermoplastics include the polyamides, which are used in somewhat the same fashion, or as a synthetic fabric; and the other commercially-available synthetic fibers such as Dacron, Orlon, Acrilan, Dynel, Creslan, and Zefran.

"Plant Engineering Practice." By the Editors of Plant Engineering. F. W. Dodge Corp., in cooperation with Technical Publishing Co., 119 West 40th St., New York, N.Y. Cloth, 8¾ by 12 inches, 694 pages. Price, $18.50.

The book actually is a compilation of articles which have appeared previously in Plant Engineering magazine. The following 13 sections are covered: sites and layout; construction; housekeeping and safety; materials handling; maintenance; paints and protective coatings; mechanical power and piping systems; electric power; lighting; utilities; heating, ventilating, and air conditioning; instrumentation and quality control; and shopwork. Within these sections are 226 detailed studies, and over 800 illustrations. Statistical data and schematic drawings are included.

"Resins — Rubbers — Plastics Yearbook 1957." Edited by H. Mark, E. S. Proskauer, and V. J. Frilette. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N.Y. Cloth, 6¾ by 9¾ inches, 1,147 pages. Price, $35.00.

Issued with the cooperation of the Institute of Polymer Research, Polytechnic Institute of Brooklyn, this work is actually a collection of abstracts in monograph form. These differ, however, from conventional abstracts both in form and the amount of information included. Subjects of the original papers, which were published during 1957, deal with the properties and behavior of resins, rubbers, and plastics. They constitute, in the opinion of the editors, the outstanding domestic and foreign papers on polymers.

Information includes original data, graphs, charts, photographs, and tables; as well as author, author's company affiliation, publication, title, actual experiment, results, and discussion. Some of write-ups do not carry over to the verso side of the page, and there are actually fewer pages than the 1,147 pages indicate.

"Cope's Plastics Book." Dwight Cope. Goodheart-Willcox Co., Inc., 1322 South Wabash, Chicago 5, Ill. 272 pages.

Following about 30 pages of history and data on the types of plastic in present day use, this book outlines over 90 projects made from plastics. A great deal of the text concerns working plastics—drilling, sawing, threading, machining, sanding, polishing, welding, cementing, and bonding. A separate chapter is devoted to the working of acrylics and other chapters are concerned with all types of materials and end products which can be worked out in a school or a home workshop. Laminates and work with the wet lay-up of polyesters and glass cloth are considered. Style is easy, and the book requires no previous knowledge of plastics.

"Progress in Plastics 1957." Edited by Phillip Morgan. Philosophical Library, Inc., 15 East 40th St., New York 16, N.Y. Cloth, 6 by 10 inches, 402 pages. Price, $22.50.

This work represents a collection of papers presented at the British Plastics Convention of 1957, edited by the editor of British Plastics magazine. In addition, many of the texts are more complete than the original paper which was limited as to length. The papers are international in scope, with eight of the 18 coming from outside the United Kingdom. A full transcript of all discussions is included.

Breakdown of the papers is as follows: polyolefins, three papers; polythene (polyethylene), three; PVC, three; extrusion, three; injection molding, three; material developments, two; and glass-reinforced plastics, two. Charts, graphs, tabular data, and illustrations are included.

"Film Formation, Film Properties, and Film Deterioration." Edited by Charles R. Bragdon. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N.Y. Cloth, 6 by 9¼ inches, 437 pages. Price, $9.75.

A study by the research committee of the Federation of Paint and Varnish Production Clubs, the book describes the various phenomena which occur during the lifetime of a "paint" film. It begins with a discussion of film research, past and present, and the preparation of 23 vehicles and their pigmentation. Chapters are included on spectrophotometric measurements, analysis, absorbency, and the like; followed by a description of exposure testing, accelerated weathering, and other tests. The latter includes oxidation studies, porosity studies, and testing for oxygen penetration, yellowing, gloss, molecular size, and stress-strain relationships.

Abstracts of Important Articles

Materials

"Dilatometric Properties and Structure of Isomeric Polymers of Ethylene and Alpha-Olefines," F. Danusso, G. Moraglio, and G. Natta, *Ind. Plastiques Mod.*, 10, 1, 40 (Jan. 1958).

Details are given of experiments leading to the establishment of formulas by which the crystallinity of polyolefines can be determined quickly with the aid of a single density measurement. Specific volumes of different polyethylenes, and stereoisometric polymers of polypropylene and polybutylene were determined in relation to temperature. The dilatometric curves of crystalline polymers showed clear correlations with their structure in the terminal fusion range. Glassy transition temperatures were determined by measurements of volumes at low temperature. (In French).

"Determination of the Volatility of Plasticizers in PVC Compounds," L. Rossig, *Kunststoffe*, 48, 1, 41 (Jan. 1958).

Volatility of plasticizers were determined in relation to time and temperature by loss of weight. After 24 hours at temperatures up to 120° C., plasticizer loss from PVC compounds was highest for dibutylphthalate; lowest for the polymeric plasticizer Ultramoll 1, closely followed by tricresylphosphate; next came Mesamoll and DOP. Values for DOP are better at lower temperatures and shorter times, while Mesamoll is better at elevated temperatures over longer periods of time, a difference explained by their different structures. (Mesamoll is a mixture of alkyl sulfonic acid esters; DOP, a homogeneous phthalic acid ester.) Results of parallel tests on plasticizer alone gave similar results. Further tests showed that volatility data are not affected by the type of PVC, and that the thickness of the PVC film is an important factor in plasticizer loss. (In German.)

"Polycondensation of 11-Aminoundecanoic Acid and Spinning Rilsan Polyamids," L. Notarbartolo, *Ind. Plastiques Mod.*, 10, 2, 44 (Feb. 1958).

After explaining the preparation of 11-Aminoundecanoic Acid and its properties, the author considers the different polycondensation systems for obtaining polyamids and the methods of making polyamide fibers. He then describes the commercial process for the polycondensation of Rilsan polyamide in an installation which makes it possible to produce the polymer in a fused state and to spin it continuously. The simplicity of the process for making Rilsan fiber is contrasted with the methods required for the polyamides 66 and 6. (In French.)

"Plasticization of Synthetic High Polymers," H. Passedouet, *Ind. Plastiques Mod.*, 10, 2, 49; 10, 3, 39 (Feb. & March 1958).

Taking the plasticization of PVC as type, the author reviews the research that has been done so far on the mechanism of plasticization. The thermodynamics of polymer-plasticizer interaction; and the variations of certain characteristics of the vinyl compound (behavior in cold, electrical properties) and of the plasticizer (viscosity, efficiency, and exudation) are discussed. Next, the dipolar theory of the interaction is dealt with and the gel structure of the plasticized polymer is examined as a means of interpreting its properties and reactions to external influences. Finally considered are the practical aspects of plasticization, the properties of the different types of plasticizers, and their effects on PVC compounds. (In French.)

"Resistance of Plastic-Bonded Metal to Water and Solvents," I. Bursztyn, *Plaste u. Kautschuk* 4, 7, 251 (July 1957).

A comprehensive table is introduced to amplify and correct earlier data published on the tensile shear strength of eight adhesives tested as bonding agents for Alclad in aging test periods up to six months. It is noted that epoxy resin binders lost much of their high electrical and water resistance when used in contact with metal, and that phenol-formaldehyde resins were far more resistant to most media than the epoxies. (In German.)

"Encapsulating Airborne Electronics," L. A. Dixon, Jr., *SPE J.*, 14, 5, 34 (May 1958).

A brief discussion of epoxy resin systems that have been developed to protect electrical components over a wide temperature range. Data are given on properties of rigid epoxy systems that are amine and anhydride cured; flexible epoxy made with trimer acid system; and a typical epoxy made with the silicone system.

"New Epoxy Resins," J. D. Bassin, *SPE J.*, 14, 5, 36 (May 1958).

Chemical reactions for epoxy resin manufacture are discussed. Special mention is made of bis-phenol A, Novolac, glycerine, and peroxide epoxies; epoxy resin converters; and recent developments in the resins.

"High-Temperature Epoxy Resins for Reinforced Plastics," J. M. Thomas, *SPE J.*, 14, 5, 39 (May 1958).

A brief article on methods for obtaining high-temperature performance by means of curing agents.

"Self Expanding Polystyrene Foam, A New Low Density Molding Material," J. A. Struthers, *Western Plastics*, 5, 4, 20 (April 1958).

Engineering properties of self-expanding polystyrene foam moldings are described, and special attention is given to heat distortion temperature versus bulk density, and compressive strength versus density.

"Effects of Plasticizers on the Fusion of Vinyl Plastisols," L. A. McKenna, *Modern Plastics*, 35, 10, 142 (June 1958).

A simple, reliable test for determining the minimum fusion temperature for plastisols, and the results obtained thereby, are described. It is shown that the relative viscosity of a plastisol can be used as a guide to determining the fusion time and temperature that will be required in production.

"Behavior of Reinforced Plastics at Very High Temperatures," I. J. Gruntfest and L. H. Shecker, *Modern Plastics*, 35, 10, 155 (June 1958).

Data relevant to the design of high-speed aircraft and missiles using reinforced plastics are presented and discussed. It is shown that reinforced organic plastics are

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in September.

competitive with refractory metals and ceramics for structures that are exposed to very hot gases at temperatures of 4,500° F. and above.

Equipment

"Screw-Extruder Pumping Efficiency," P. H. Squires, *SPE J.*, 14, 5, 24 (May 1958).

Efficiency as influenced by relative channel depth and curvature is discussed in terms of one-dimensional extrusion theory, two-dimensional extrusion theory, and partially-empty screws.

Processing

"Vinyltoluene for Polyester Premix Putties," R. F. Helmreich, *Modern Plastics*, 35, 10, 168 (June 1958).

Preparation methods for premix monomers are compared, and the properties of the resulting premixes in putty forms are described.

"Factors Affecting Quality in Polyethylene Extrusion," B. H. Maddock, *Plastics Ind.*, 15, 11, 16 (Nov. 1957).

Factors discussed include screw designs, speeds, and temperatures; operating conditions; and mixing efficiency.

Applications

"Properties and Applications of Low-Pressure Polyethylene," J. von Klenck and E. Grams, *Trans., Plastics Inst.* 25, 62, 250 (Oct. 1957).

Facts based on experience gained with "Hostalen" (the polyethylene produced by Farbwerke Hoechst, Germany) chiefly are dealt with. Fundamental problems and the explanation of characteristic features and difficulties are considered.

"Some New Applications of Epoxy Resins on the Continent," K. Meyerhans, *Trans. Plastics Inst.* 25, 62, 267 (Oct. 1957).

Examples are given of the application of Araldite in medicine; the chemical, vehicle, and electrical industries; foundries; and in the construction of rockets.

"Silicones in the Plastics and Rubber Industries," J. J. Newland, *Trans. Plastics Inst.*, 25, 62, 311 (Oct. 1957).

Silicone bonding materials for producing glass and asbestos laminates and moldings, and the uses of these products are considered. Their electrical and thermal behavior is shown in graphs and tables. The place of silicone rubbers as insulations for electrical machines, in the aircraft and cable industries, and in molding bags for the plastics industry is discussed. Mention is made of the production of room-temperature vulcanizing silicone rubbers in the United States and Germany.

General

"Removal of Silica from Water for Steam Generators," G. A. Paparelle, *Materie Plastiche*, 23, 5, 361 (May 1957).

The removal of silica from water for steam generators by treatment with calcium-magnesium and a cationic resin, and by ion-exchange methods, is described and compared. It is shown that for modern steam generators, the latter is the only efficient method. (In Italian.)

"Tolerances for Molded Parts and Injection Moldings," *Kunststoffe*, 47, 11, 669 (Nov. 1957).

Tolerances and permissible deviations for molded parts and injection moldings are established in the German Standard DIN-7710, first published in 1951. Since a revision has now become necessary, proposed changes have been published in two new DIN-7710 sheets; Sheet 1 applying to molded parts, and Sheet 2 to injection moldings. (In German.)

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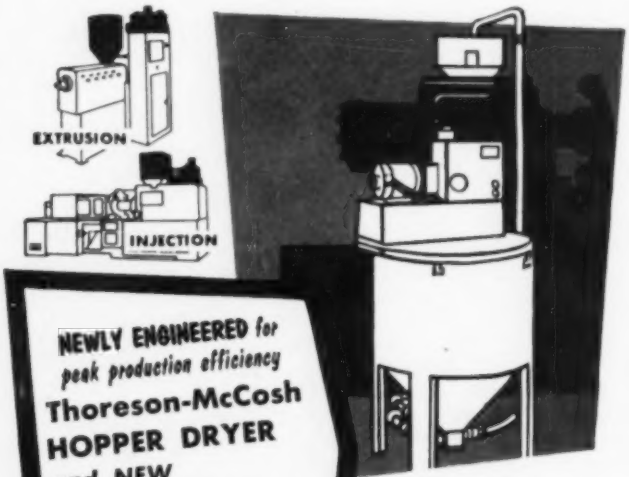

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Patent Digest

Materials

Process of Preparing Polyacrylamide. No. 2,820,777. Tzeng Jiueq Suen and Arthur M. Schiller, New Canaan, Conn. (to American Cyanamid Co., New York, N. Y.).

A continuous process for polymerizing and hydrolyzing acrylamide and its alkyl alpha-substituted derivatives consists of reacting the material in the presence of a polymerization catalyst and an alkali metal hydroxide at a temperature of 50-100° C.

Vinyl-Compatible Resins Based on 2, 4-Dimethyl-4-Hydroxyethoxymethyl-1, 5-Pentanediol. No. 2,819,235, Carl H. Fink, Pittsburgh, and Kenneth L. Brown, Library, Pa. (to Union Carbide Corp., New York, N. Y.).

The resins are polyesters of 2, 4-dimethyl-4-hydroxyethoxymethyl-1, 5-pentanediol and almost equal parts of dicarboxylic and monocarboxylic acids.

Halogenated Olefin Polymers Plasticized with a Telomer Containing Perfluorochloroolefin Monomer Units and Method of Preparing Same. No. 2,820,772. William S. Barnhart, Cranford, N. J. (to Minnesota Mining & Mfg. Co., St. Paul, Minn.).

The thermoplastic composition is obtained by polymerizing a halogenated olefin with an open-chain, distillable telomer containing a plurality of perfluorochloroolefin monomer units and halogen terminal groups as a plasticizer.

Secondary-2-N-Octyl Primary-N-Heptyl Phthalate and Synthetic Plastics Containing Same. No. 2,820,771. Andre Henri Passedouet, Benzons, France. (to Consortium de Produits Chimiques et de Synthese, Benzons, France).

The above mentioned material can be used successfully as a plasticizer for PVC, polyvinylidene chloride, copolymer of vinyl chloride and vinyl acetate, nitrocellulose, and polystyrene.

Epoxy - Modified Urea - Formaldehyde Condensation Product and Method of Making Same. No. 2,819,238. Raymond G. Hart and Clarence J. Gardner, Jr., Bainbridge, N. Y. (to The Borden Co., New York, N. Y.).

The partially-condensed, water-soluble, viscous cationic material resulting from the heating of an aliphatic polyhydric alcohol with epichlorohydrin, acid, and an aliphatic polyamine is mixed with formaldehyde and urea. This mixture is heated to a temperature between 40° C., and boiling point of the mixture until the resultant condensation produces a viscous solution. The pH is then adjusted to about 7-8.

Process of Preparing an Organopolysiloxane-Modified Polyester Resin, the Product Thereof, and Electrical Conductor Coater Therewith. No. 2,821,508. Leonard E. Edelman and Sydney Robbins, Pittsburgh, Pa. (to Westinghouse Electric Corp., East Pittsburgh, Pa.).

A polyhydric alcohol is admixed with an isophthalic acid, heated at 200-210° C., separated from the water of esterification, cooled to 150° C., admixed with an organopolysiloxane, and heated again at 130-200° C.

Stabilized Polyethylene Compositions. No. 2,820,775. Malcolm Chamberlain, Raymond H. Rigterink, and Charles L. Stacy, Jr., Midland, Mich. (to Dow Chemical Co. Midland, Mich.).

Polyethylene is stabilized against thermal oxidation through the addition of 0.0005-2% by weight of a 4,4-methylene-bis-2,6-dialkyl phenol as an anti-oxidant.

Flame-Resistant Polyester Resinous Compositions Containing Combined Halogens and Phosphorus and Process of Preparation. No. 2,819,247. Lennart A. Lundberg, Stamford, Conn. (to American Cyanamid Co., New York, N. Y.).

A polyhydric alcohol and an ethylenically-unsaturated polycarboxylic acid are reacted with an alkyl phosphate to produce a polymerizable polyester. The resulting product is then reacted with a compound containing a polymerizable ethylene group and having a boiling point of at least 60° C.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.
—The Editor

Stabilized Chloro-Ethylene Polymer-Containing Lacquer. No. 2,823,191. Werner Gysin, Ludwigshafen, Germany. (to Badische Anilin- & Soda-Fabrik, A. G., Ludwigshafen, Germany.).

An ethyleneimine or a polyethyleneimine together with a copolymer consisting of a chlorine containing monomer and at least one polymerizable, monomeric, monoethylenic compound are dissolved in an organic lacquer solvent to produce an improved lacquer composition.

Polyamide-Epoxy Resin Reaction Product. No. 2,823,189. Don E. Floyd, Robbinsdale, Minn. (General Mills, Inc., Minneapolis, Minn.).

The material contains terminal epoxy groups derived from a polyhydric phenol and epichlorohydrin together with a polymeric polyamide having free amine groups.

Process for the Manufacture of Organic Isocyanates. No. 2,822,373. Theodore R. Beck, Wilmington, Del. (to E. I. du Pont de Nemours and Co., Wilmington, Del.).

In the continuous flow process for manufacturing organic isocyanates, an inert organic solution of the amine is passed into a similar solution of phosgene under superatmospheric pressure and conditions of turbulent flow. The amount of phosgene employed is in the ratio of 1.25 mols per NH_2 group. Temperatures are maintained between 90-180° C.

Equipment

Circular Extrusion Die. No. 2,824,337. Robert A. Covington, Jr., and Vincent H. Waldin, Wilmington, Del. (to E. I. du Pont de Nemours and Co. Wilmington, Del.).

Made from a relatively rigid material, the die is provided with a retaining cavity and a coaxially-disposed annular extrusion passage. A flow-directing surface is located in the cavity, ahead of the orifice and terminating at its inner end. The flow-directing surface together with one surface of a ring element, defines a plastic-supplying exit opening into the extrusion passage. Preselected, discrete portions of the ring element are advanced or retracted by an adjusting device.

Nozzle Locating Device. No. 2,821,750. Donald A. Huelskamp, Mt. Gilead, O. (to Koehring Co., Milwaukee, Wis.).

An injection nozzle, mounted on the frame of a molding machine, is arranged for separable engagement with a mold part. A die head, also mounted on the frame, incorporates an adjustable ring that engages the part and holds it in the desired position relative to the nozzle.

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In Brief . . . *(Cont'd from pg. 754)*

Lauren B. Hitchcock Associates, chemical engineers, have set up offices at 60 East 42nd St., New York City, to conduct industrial research, development counseling, commercial chemical development, technical investigation, and market survey work. Company officers are L. B. Hitchcock, former vice president of Quaker Oats' chemical department; and Edwin Cox, former vice president of Virginia-Carolina Chemical Corp.

B. F. Goodrich Industrial Products Co., Marietta, O., and Sherwin-Williams Co., New York, N. Y., jointly announced that S-W branches will market Koroseal vinyl wall coverings, made by the coated fabrics division of the BFG firm, in all principal marketing areas in the country.

Current Market Prices

Price Changes and Additions

Plasticizers			
Abcoflex A	lb.	$0.80 /	$2.65
B	lb.	.77 /	2.60
C	lb.	.88	
D	lb.	.83	
Conoco H-300	lb.	.08 /	.11
Santicizer 165	lb.	.27 /	.305
Resins & Molding Compounds			
Polyamide			
Catalin Nylons:			
Natural	lb.	1.18 /	1.45
Black & white	lb.	1.28 /	1.45
Colors, std.	lb.	1.37 /	1.65
Special	lb.	1.37 /	1.80
Polyethylene			
Catalin low density, nat	lb.	.35 /	.46
Black	lb.	.37 /	.54
High density, nat.	lb.	.43 /	.47
Black	lb.	.45 /	.495
Colors	lb.	.49 /	1.06
Styrenes			
Catalin, extra high impact,			
Natural & black	lb.	.385 /	.415
Colors, std.	lb.	.425 /	.445
Special	lb.	.425 /	1.00
High impact, natural & black	lb.	.32 /	.34
Colors, std.	lb.	.345 /	.385
Special	lb.	.345 /	1.00
General purpose, crystal	lb.	.2425/	.2575
Colors, std.	lb.	.2725/	.2925
Special	lb.	.2725/	1.00
Medium impact, colors, std.	lb.	.34 /	.365
Special	lb.	.34 /	1.00
Utility black, gen. purpose	lb.	.1975	
Medium impact	lb.	.215	
High impact	lb.	.26	
Vinyls			
Vygen 85	lb.	.43 /	.80
105, 161	lb.	.43 /	.93
110	lb.	.43 /	1.08
120	lb.	.43 /	1.18

CALENDAR of COMING EVENTS

Sept. 3-5
First National Conference on the Application of Electrical Insulation. AIEE and NEMA Hotels Pick-Carter and Statler-Hilton, Cleveland, O.

Sept. 7-20
31st Industrial Chemistry Conference of Liege. Federation of Belgian Chemical Industries and the Belgian Branch of the Industrial Chemical Society. Liege, Belgium.

Sept. 12
SPE Detroit Section. Regional Technical Conference. Plastics in Automotive Applications. St. Clair Inn, St. Clair, Mich.

Sept. 22-24
Seventh Annual Meeting, Standards Engineers Society. Benjamin Franklin Hotel, Philadelphia, Pa.

Sept. 29-Oct. 3
ASTE Semi-Annual Meeting and Western Tool Show. Shrine Exposition Hall, Los Angeles, Calif.

Oct. 1
SPE Western New England Section. Regional Technical Conference. Plastics in Packaging. Hotel Statler, Hartford, Conn.

Oct. 9-10
SPI 14th New England Section Conference. Wentworth-by-the-Sea, Portsmouth, N.H.

Oct. 20-22
13th Tappi Plastics-Paper Conference. Sheraton-Kimball Hotel, Springfield, Mass.

Oct. 21
SPE Upper Midwest Section. Regional f Technical Conference. Epoxies. Curtis Hotel, Minneapolis, Minn.

Oct. 24
SPE Golden Gate Section. Regional Technical Conference. Plastics and Electronics. (location unannounced).

Nov. 5-6
Annual Fall Meeting. Society of Vacuum Coaters, Hotel Statler, Detroit, Mich.

Nov. 13
SPE Southern California Section. Regional Technical Conference. Plastics in Building and Construction. Ambassador Hotel, Los Angeles, Calif.

Nov. 17-21
Eigth National Plastics Exposition. Int'l Amphitheatre, Chicago, Ill.

Domestic Production and Sales of Plastics and Resin Material, March and April, 1958

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of March and April, 1958. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

Production and sales volumes, though still slightly lower than last year's figures, are continuing the upward trend noted last month. Cellulosics, phenolics, vinyls, and ureas remained about the same; while styrenes, coumarones, and polyesters show consistently steady increases. The polyethylenes still maintain their lead, showing an approximate 25% increase with respect to last year and 10% compared to last month.

	March, 1958		April, 1958	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,680,105	1,688,241	1,275,525	1,275,286
Sheets, 0.003 gage and over	1,490,369	1,424,413	1,777,597	1,410,181
All other sheets, rods, and tubes	652,800	733,717	699,039	590,597
Molding and extrusion materials	7,652,829	7,493,412	6,452,302	6,093,484
Nitrocellulose sheets, rods, and tubes	278,414	302,070	228,650	275,027
Other cellulose plastics	736,046	571,778	775,071	511,775
TOTAL	12,490,563	12,213,631	11,208,184	10,156,350
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	14,217,363	12,832,226	10,727,605	11,514,733
Bonding and adhesive resins for—				
Laminating (except plywood)	5,131,878	3,636,293	4,473,330	2,650,601
Coated and bonded abrasives	1,127,016	840,612	1,054,929	841,529
Friction materials (brake linings, clutch facings, and similar materials)[2]	850,105	742,965	766,687	743,362
Thermal insulation (fiber glass, rock wool)	3,101,074	3,343,566	3,845,420	3,459,187
Plywood	3,840,164	3,222,919	4,021,753	3,783,864
All other bonding and adhesive uses	2,785,055	2,914,081	2,836,308	2,888,140
Protective-coating resins, unmodified and modified except by rosin	2,532,210	1,871,728	2,352,896	1,938,030
Resins for all other uses	2,207,625	1,614,212	1,677,437	1,410,322
TOTAL	35,792,490	28,104,521	31,756,365	29,229,768
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,816,694	2,566,138	2,732,453	2,424,700
Paper-treating and paper-coating resins	1,952,996	1,729,429	2,153,622	1,757,391
Bonding and adhesive resins for—				
Plywood	7,363,287	7,769,920	6,415,725	7,149,073
All other bonding and adhesive uses, including laminating	3,444,603	3,134,720	3,323,085	2,873,001
Protective-coating resins, straight and modified	2,293,155	1,678,469	2,062,556	1,799,458
Resins for all other uses, including molding	8,323,622	7,630,435	7,612,110	6,622,793
TOTAL	26,194,357	24,509,111	24,299,551	22,626,416
Styrene Resins:				
Molding materials[1]	32,933,226	34,859,878	35,769,094	37,645,917
Protective-coating resins, straight and modified	7,453,399	7,126,115	6,744,214	7,408,435
Resins for all other uses	12,905,101	10,238,934	12,098,173	10,286,202
TOTAL	53,291,726	52,224,927	54,611,481	55,340,554
Vinyl and Vinyl Chloride Resins:[3]				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		6,529,852		5,424,027
Sheeting (resin content)		4,248,373		4,642,995
Molding and extrusion (resin content)		15,340,256		15,704,906
Textile and paper treating and coating (resin content)[2]		3,862,511		3,880,560
Flooring (resin content)		9,215,843		9,079,490
Protective coating (resin content)		2,322,024		2,056,310
All other uses (resin content)		3,759,976		5,387,100
All other vinyl resins for—				
Adhesives (resin content)		3,941,289		4,086,958
All other uses (resin content)		9,036,058		9,695,572
TOTAL	62,697,790	58,256,182	54,427,238	59,857,918
Coumarone-Indene and Petroleum Polymer Resins	18,290,082	18,340,876	20,065,799	18,814,767
Polyester Resins:				
For reinforced plastics	7,658,291	6,634,641	9,220,878	8,670,937
For all other uses	978,427	778,530	745,141	829,715
TOTAL	8,636,718	7,413,171	9,966,019	9,500,652
Polyethylene Resins:				
For film		29,797,524		26,557,780
For all other uses		33,310,990		42,628,460
TOTAL	72,120,623	63,108,514	66,812,933	69,186,240
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[1, 4]	2,817,471	2,781,168	2,616,412	2,924,219
Protective-coating resins[5]	1,038,969	528,390	955,788	723,493
Resins for all other uses[6]	11,660,056	9,768,563	12,696,512	10,983,351
TOTAL	15,516,496	13,078,121	16,268,712	14,631,063
GRAND TOTALS	305,030,845	277,249,054	289,416,282	289,343,728

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, nylon, silicone, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
[7]Included with "All other bonding and adhesive uses."
SOURCE: United States Tariff Commission, Chemical Division.

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